AD-A034 245 MCDERMOTT (J RAY) CO INC NEW ORLEANS LA F/G 13/10
ENGINEERING DESIGN CALCULATIONS MONO-MOORING SYSTEM. VOLUME 4. --ETC(U)
1966 DA-44-009-AMC-841(T)

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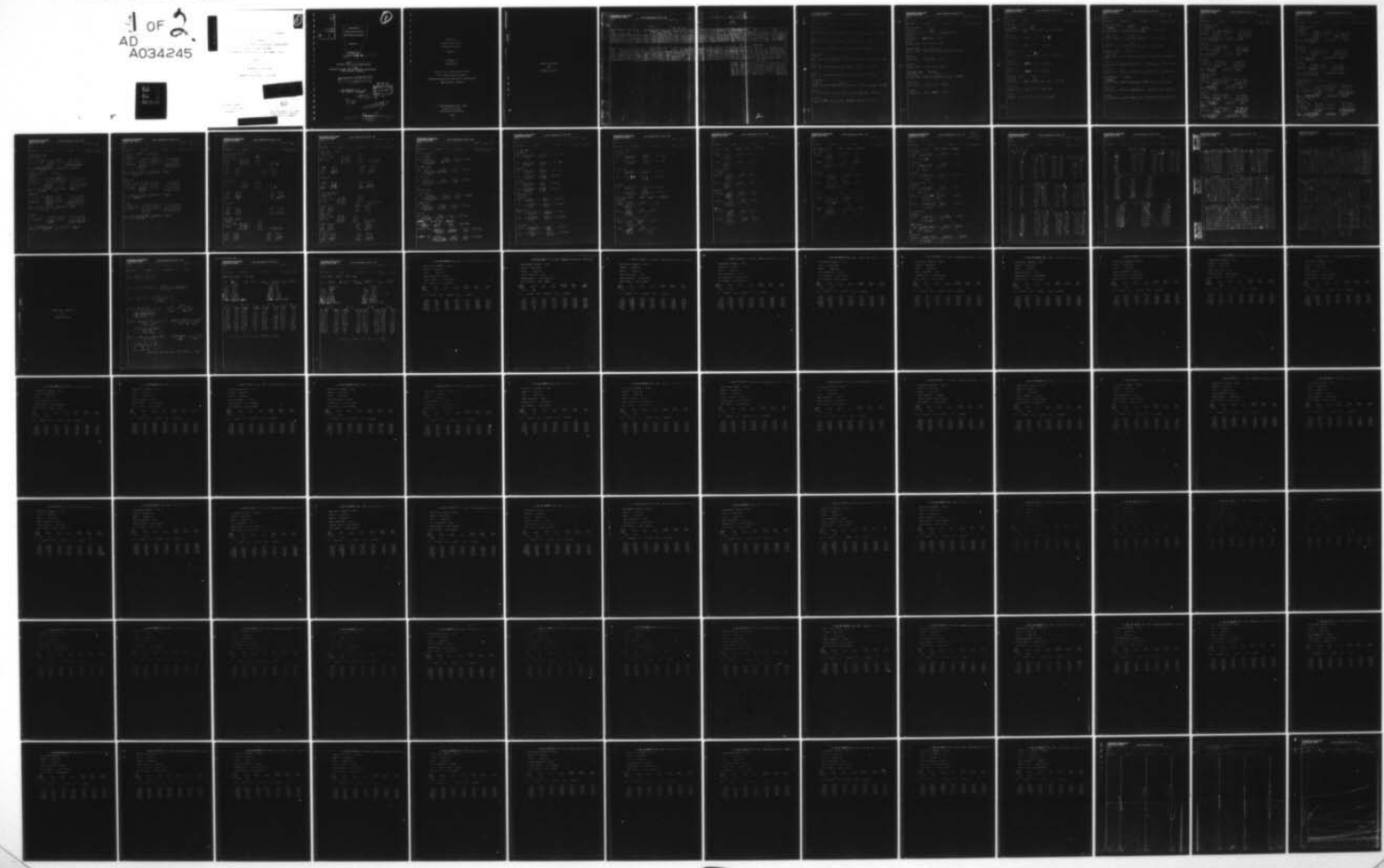

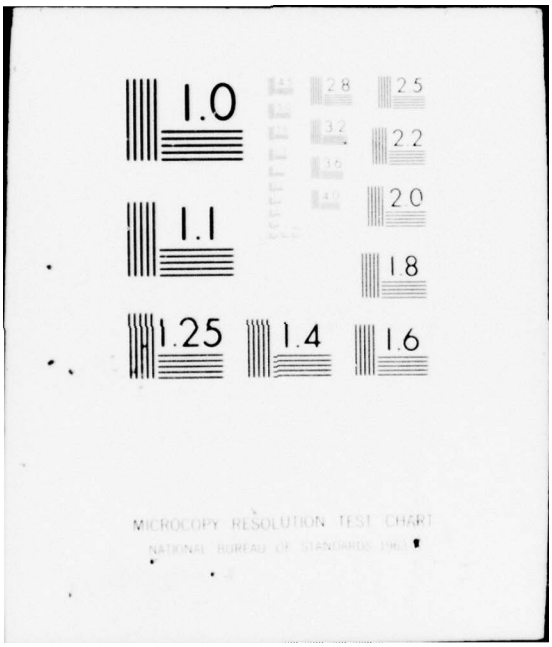
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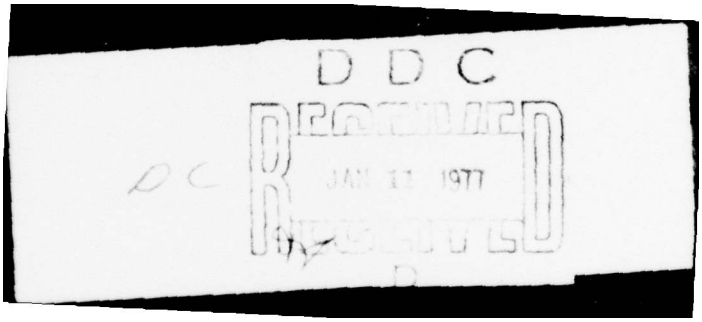
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(6) ENGINEERING
DESIGN CALCULATIONS
MONO-MOORING SYSTEM.

VOLUME 4.

APPENDIX A.
TO
(9) FINAL REPORT on Phase 1.

(15) Contract No. DA-44-009-AMC-841(T)

U. S. ARMY
ENGINEER RESEARCH AND DEVELOPMENT LABORATORIES
FORT BELVOIR, VIRGINIA

J. RAY McDERMOTT & CO., INC.
NEW ORLEANS, LOUISIANA

(12) 164p.

(11) 1966

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ENGINEERING

DESIGN CALCULATIONS

MONO-MOORING SYSTEM

VOLUME 4

APPENDIX A
to
FINAL REPORT

Contract No. DA-44-009-AMC-841(T)

U. S. ARMY MATERIEL COMMAND

ENGINEER RESEARCH AND DEVELOPMENT LABORATORIES

FORT BELVOIR, VIRGINIA

J. RAY McDERMOTT & CO., INC.
Saratoga Building
New Orleans, Louisiana

1966

SECTION I

TANKER PROPERTIES

FOR

MOORING STUDIES

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY | SHEET NO. 1

SUBJECT

DRAWING NUMBER | COMPUTER | CHECKED BY | DATE 11-18-65

DWT TONS	L O.A	L WL	B	D	LOADED T	BALLAST TM	BALLAST TA	BALLAST TF	LIGHT T	LOADED Δ^K	BALLAST Δ^K
22,500	595.0	579.2	77.0	42.7	32.4	17.8	25.9	9.7	11.3	70,093	35,049
46,000	736.0	718.0	102.0	50.0	37.8	20.8	30.2	11.3	13.2	132,503	66,25[illegible]
70,000	859.0	839.1	115.0	60.0	44.0	24.2	35.2	13.2	15.4	204,315	102,49[illegible]

DWT TONS	VIRTUAL MASS OF HEAVE LOADED	VIRTUAL MASS OF HEAVE BALLAST	VIRTUAL MASS OF HEAVE LIGHT	K PITCH = K YAW LOADED	K PITCH = K YAW BALLAST	K PITCH = K YAW LIGHT	K ROLL LOADED	K ROLL BALLAST	K ROLL LIGHT	HEAVE PERIOD LOADED	HEAVE PERIOD BALLAST	HEAVE PERIOD LIGHT
22,500	131,545	92,846	74,513	192.8	205.9	214.3	29.8	32.8	34.9	8.2	7.0	6.3
46,000	264,986	190,103	159,218	240.5	256.0	265.6	38.1	44.4	46.8	9.1	7.[illegible]	7.2
70,000	400,116	286,479	231,538	280.6	298.9	310.4	43.3	49.7	52.6	9.8	8.4	7.7

TANKER PROPERTIES FOR MOTION STUDY

1

DED	BALLAST	LIGHT	LOADED	BALLAST	LIGHT	LOADED	BALLAST	LIGHT	GM			GM_L		
K	Δ^K	Δ^K	α	α	α	K/FT	K/FT	K/FT	LOADED	BALLAST	LIGHT	LOADED	BALLAST	LIGHT
22	35,049	21,029	0.844	0.820	0.787	2.409	2.391	2.346	11.0	15.1	22.8	460'	485.0	558.4
503	66,255	39,753	0.833	0.812	0.782	3.304	3.806	3.665	15.0	20.0	29.4	530'	621.7	715.4
315	102,493	61,495	0.836	0.814	0.784	5.163	5.027	9.442	16.0	21.8	32.0	670'	706.2	812.9

60' WD

EAVE PERIOD			ROLL PERIOD			PITCH PERIOD			SURGE PERIOD			SWAY PERIOD			YAW PERIOD		
	BALLAST	LIGHT	LOADED	BALLAST	LIGHT	LOADED	BALLAST	LIGHT	LOADED	BALLAST	LIGHT	LOADED	BALLAST	LIGHT	LOADED	BALLAST	LIGHT
	7.0	6.3	10.2	9.3	8.1	10.0	10.4	10.0	11.1	8.2	6.6	92.1	87.1	81.0	92.1	87.1	81.0
	7.2	7.2	10.3	11.0	9.6	11.0	10.3	11.0	14.5	10.8	8.6	144.8	131.3	122.6	144.8	131.3	122.6
	8.4	7.7	12.0	11.8	10.3	12.0	12.5	12.1	19.4	14.3	11.5	184.0	166.4	155.6	184.0	166.4	155.6

150' WD

DWT	SURGE PERIOD			SWAY PERIOD			YAW PERIOD		
TONS	LOADED	BALLAST	LIGHT	LOADED	BALLAST	LIGHT	LOADED	BALLAST	LIGHT
27,500	17.0	12.6	10.0	82.5	74.1	63.0	82.5	74.1	63.0
46,000	22.1	16.9	13.1	123.9	111.7	104.9	123.9	111.7	104.9
70,000	29.6	22.0	17.5	150.7	141.5	132.3	150.7	141.5	132.3

2

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

0.74 ... =
0.374

COMPANY

SHEET NO 2

SUBJECT

DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 11-18-68

22,500 DWT

LOADED

$M_{VH} = 70,099 + 0.3925 \times 579.2 \times 77.0^2 \times 0.849^2 \times 0.064 = 70,099 + 61,446 = 131,545$ (86,264)

BALLAST

$M_{VH} = 35,049 + 86,264 \times 0.820^2 = 35,049 + 57,797 = 92,846$

LIGHT

$M_{VH} = 21,029 + 86,264 \times 0.787^2 = 21,029 + 53,484 = 74,513$

46,000 DWT

LOADED

$M_{VH} = 132,509 + 0.3925 \times 718.0 \times 102.0^2 \times 0.064 \times 0.833^2 = 132,509 + 129,477 = 261,986$ (187,648)

BALLAST

$M_{VH} = 66,255 + 187,648 \times 0.812^2 = 66,255 + 123,848 = 190,103$

LIGHT

$M_{VH} = 39,753 + 187,648 \times 0.782^2 = 39,753 + 114,465 = 154,218$

70,000 DWT

LOADED

$M_{VH} = 204,985 + 0.3925 \times 839.1 \times 115.0^2 \times 0.064 \times 0.836^2 = 204,985 + 195,131 = 400,116$ (278,759)

BALLAST.

$M_{VH} = 102,493 + 278,759 \times 0.814^2 = 102,493 + 183,981 = 286,474$

LIGHT

$M_{VH} = 61,495 + 278,759 \times 0.781^2 = 61,495 + 170,043 = 231,538$

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO. 3
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 11-18-65

22,500 DWT SURGE

LOADED 147.1

ADDED MASS = $0.3925 \times 32.4 \times 72.0^2 \times 0.064 \times 0.994^2 = 4,766$

BALLAST

ADDED MASS = $147.1 \times 17.8 = 2,618$

LIGHT

ADDED MASS = $147.1 \times 11.3 = 1,662$

46,000 DWT LOADED SURGE 213.8

ADDED MASS = $0.3025 \times 102.0^2 \times 0.064 \times 0.994^2 \times 37.8 = 8,082$

BALLAST

ADDED MASS = $213.8 \times 20.8 = 4,447$

LIGHT

ADDED MASS = $213.8 \times 13.2 = 2,822$

70,000 DWT SURGE

LOADED 328.2

ADDED MASS = $0.3925 \times 115.0^2 \times 0.064 \times 0.994^2 \times 44.0 = 14,491$

BALLAST

ADDED MASS = $328.2 \times 29.2 = 7,942$

LIGHT

ADDED MASS = $328.2 \times 15.4 = 5,054$

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO 4
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 11-18-65

22,500 DWT SWAY

LOADED

ADDED MASS = $\frac{3.14}{4} \times 579.2 \times 0.064 \times 29.1^2 \times 29.1^2 = 30,549$

BALLAST

ADDED MASS = $29.1 \times 17.8^2 = 9,219$

LIGHT

ADDED MASS = $29.1 \times 11.3^2 = 3,716$

46,000 DWT SWAY

LOADED

ADDED MASS = $0.7850 \times 718.0 \times 0.064 \times 36.0^2 = 51,437$

BALLAST

ADDED MASS = $360 \times 20.8^2 = 15,574$

LIGHT

ADDED MASS = $360 \times 13.2^2 = 6,271$

70,000 DWT SWAY

LOADED

ADDED MASS = $0.7850 \times 839.1 \times 0.064 \times 42.2^2 = 81,699$

BALLAST

ADDED MASS = $42.2 \times 29.2^2 = 29,712$

LIGHT

ADDED MASS = $42.2 \times 15.4^2 = 10,010$

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY MCDERMOTT & CO., INC.

COMPANY | SHEET NO 5

SUBJECT

DRAWING NUMBER | COMPUTER | CHECKED BY | DATE 11-18-65

22,500 DWT ROLL

LOADED 8,653 14825

J ADDED MASS = $(170,099 - 61,446) \times \left(\frac{770}{2}\right)^2 = 12,825,909$

BALLAST 22,798

J ADDED MASS = $(57,797 - 35,099) \times \left(\frac{77}{2}\right)^2 = 33,718,223$

LIGHT 32,455

J ADDED MASS = $(53,989 - 21,023) \times \left(\frac{77}{2}\right)^2 = 98,106,424$

46,000 DWT ROLL

LOADED

J ADDED MASS = $(132,509 - 129,477) \times \left(\frac{103}{2}\right)^2 = 3,032 \times 2,601.0 = 7,886,232$

BALLAST

J ADDED MASS = $(123,848 - 66,255) \times 2,601.0 = 57,593 \times 2,601.0 = 149,799,393$

LIGHT

J ADDED MASS = $(119,465 - 39,753) \times 26010 = 79,712 \times 2,601.0 = 199,325,912$

70,000 DWT ROLL

LOADED

J ADDED MASS = $(269,985 - 195,131) \times \left(\frac{115}{2}\right)^2 = 9,854 \times 3,306.3 = 32,580,280$

BALLAST

J ADDED MASS = $(183,781 - 102,493) \times 3,306.3 = 81,488 \times 3,306.3 = 269,423,774$

LIGHT

J ADDED MASS = $(170,093 - 64,995) \times 3,306.3 = 108,548 \times 3,306.3 = 358,892,252$

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY MCDERMOTT & CO., INC.

COMPANY			SHEET NO 6
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 11 18 65

22,500 DWT

LOADED

$J_{SHIP} = 70,099 \times (0.37 \times 811.7 \times 77)^2 = 56,899,358$

$J_{ADD\ MASS} = \frac{8,653}{78,752} \times 1,482.25 = \frac{12,825,909}{69,725,267}$

$K_R = \sqrt{\frac{69,725,267}{78,752}} = \sqrt{885.4} = 29.8'$

BALLAST

$J_{SHIP} = 35,049 \times 811.7 = 28,449,273$

$J_{ADD\ MASS} = \frac{22,748}{57,797} \times 1,482.3 = \frac{33,718,223}{62,167,496}$

$K_R = \sqrt{\frac{62,167,496}{57,797}} = \sqrt{1076.6} = 32.8$

LIGHT

$J_{SHIP} = 21,029 \times 811.7 = 17,069,290$

$J_{ADDED\ MASS} = \frac{32,455}{53,484} \times 1482.3 = \frac{48,106,429}{65,175,663}$

$K_R = \sqrt{\frac{65,175,663}{53,484}} = \sqrt{1,218.6} = 34.9$

46,006 DWT

LOADED

$J_{SHIP} = 132,509 \times (0.37 \times 102 \times 1424.3)^2 = 188,737,569$

$J_{ADD\ MASS} = \frac{3,032}{135,541} \times 2,601.0 = \frac{7,886,232}{196,618,801}$

$K_R = \sqrt{\frac{196,618,801}{135,541}} = \sqrt{1450.6} = 38.1$

BALLAST

$J_{SHIP} = 66,255 \times 1424.3 = 94,366,997$

$J_{ADD\ MASS} = \frac{57,523}{173,848} \times 2,601.0 = \frac{149,799,393}{244,166,390}$

$K_R = \sqrt{\frac{244,166,390}{123,848}} = \sqrt{1,971.5} = 44.4$

LIGHT

$J_{SHIP} = 39,753 \times 1,424.3 = 56,620,198$

$J_{ADD\ MASS} = \frac{74,712}{114,465} \times 2,601.0 = \frac{194,325,912}{250,946,110}$

$K_R = \sqrt{\frac{250,946,110}{114,465}} = \sqrt{2,192.3} = 46.8$

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO 7
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 11-18-65

70,000 DWT

LOADED

$J_{SHIP} = 204,985 \times (0.37 \times 115)^2 \times \frac{1,810.5}{3,306.3} = 371,125,343$

$J_{ADD\ MASS} = \frac{9,854}{214,839} \times 3,306.3 = \frac{32,580,280}{403,705,623}$

$K_R = \sqrt{\frac{403,705,623}{214,839}} = \sqrt{1,879.1} = 43.3$

BALLAST

$J_{SHIP} = 102,493 \times 1,810.5 = 185,563,577$

$J_{ADD\ MASS} = \frac{81,488}{183,981} \times 3,306.3 = \frac{269,423,774}{454,987,351}$

$K_R = \sqrt{\frac{454,987,351}{183,981}} = \sqrt{2,473.0} = 49.7$

LIGHT

$J_{SHIP} = 61,495 \times 1,810.5 = 111,336,698$

$J_{ADD\ MASS} = \frac{108,598}{170,093} \times 3,306.3 = \frac{358,892,252}{470,228,950}$

$K_R = \sqrt{\frac{470,228,950}{170,093}} = \sqrt{2,765.4} = 52.6$

22,500 DWT PITCH

LOADED

$J_{LIGHT\ SHIP} = 21,029 \times (0.37 \times 579.2)^2 \times \frac{45,924.5}{22,500} = 965,746,311$

$J_{LOAD} = 19,070 \times (0.7 \times 0.37 \times 579.2)^2 = 1,104,075,000$

$J_{ADD\ MASS} = \frac{61,446}{131,545} \times 45,924.5 = \frac{2,821,876,827}{4,891,698,138}$

$K_P = \sqrt{\frac{4,891,698,138}{131,545}} = \sqrt{37,186.5} = 192.8$

BALLAST

$J_{LIGHT\ SHIP} = 21,029 \times 45,924.5 = 965,746,311$

$J_{BALLAST} = 14,020 \times 22,500.0 = 315,450,000$

$J_{ADD.\ MASS} = \frac{57,297}{92,846} \times 45,924.5 = \frac{2,654,298,327}{3,935,494,638}$

$K_P = \sqrt{\frac{3,935,494,638}{92,846}} = \sqrt{42,387.3} = 205.9$

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY MCDERMOTT & CO., INC.

COMPANY			SHEET NO 8
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 11-10-65

22,500 DWT
LIGHT

J LIGHT SHIP = 21,029 × 45,924.5 = 965,746,311
J ADD. MASS = 53,484 × 45,924.5 = 2,456,225,958
79,513 3,421,972,269

$K_p = \sqrt{\frac{3,421,972,269}{79,513}} = \sqrt{45,924.5} = 214.3$

46,000 DWT PITCH
LOADED 70,569.9

J LIGHT SHIP = $39,753 \times (0.37 \times 716.0)^2$ = 2,805,365,235
J LOAD = $92,756 \times (0.7 \times 0.37 \times 716.0)^2$ = 3,208,986,576
J ADD. MASS = $\frac{129,477}{261,986} \times 70,569.9$ = 9,137,178,992
15,151,530,753

$K_p = \sqrt{\frac{15,151,530,753}{261,986}} = \sqrt{57,833.4} = 240.5$

BALLAST

J LIGHT SHIP = 39,753 × 70,569.9 = 2,805,365,235
J BALLAST = 26,502 × 39,596.0 = 916,863,192
J ADD MASS = $\frac{123,848}{190,103} \times 70,569.9$ = 8,739,940,975
12,462,169,402

$K_p = \sqrt{\frac{12,462,169,402}{190,103}} = \sqrt{65,554.8} = 256.0$

LIGHT

J LIGHT SHIP = 39,753 × 70,569.9 = 2,805,365,235
J ADD MASS = $\frac{114,465}{154,218} \times 70,569.9$ = 8,077,783,604
10,883,148,839

$K_p = \sqrt{\frac{10,883,148,839}{154,218}} \cdot \sqrt{70,569.9} = 265.6$

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY MCDERMOTT & CO., INC.

COMPANY			SHEET NO 9
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 11-18-65

70,000 DWT PITCH

LOADED

$\sqrt{J}$ LIGHT SHIP = $61,495 \times (0.37 \times 839.1)^2 = 5,926,838,909$

$\sqrt{J}$ LOAD = $143,490 \times (0.7 \times 0.37 \times 839.1)^2 = 6,775,497,357$

$\sqrt{J}$ ADD MASS = $\frac{195,131}{400,116} \times 96,379.2 = 18,806,569,675$

$31,509,005,936$

$K_p = \sqrt{\frac{31,509,005,936}{400,116}} = \sqrt{78,749.7} = 280.6$

BALLAST

$\sqrt{J}$ LIGHT SHIP = $61,495 \times 96,379.2 = 5,926,838,909$

$\sqrt{J}$ BALLAST = $40,598 \times 47,219.3 = 1,939,996,661$

$\sqrt{J}$ ADD MASS = $\frac{183,981}{286,474} \times 96,379.2 = 17,731,941,595$

$25,598,777,160$

$K_p = \sqrt{\frac{25,598,777,160}{286,474}} = \sqrt{89,358.1} = 298.9$

LIGHT

$\sqrt{J}$ LIGHT SHIP = $61,495 \times 96,379.2 = 5,926,838,909$

$\sqrt{J}$ ADD MASS = $\frac{170,043}{231,538} \times 96,379.2 = 16,388,608,306$

$22,315,447,210$

$K_p = \sqrt{\frac{22,315,447,210}{231,538}} = \sqrt{96,379.2} = 310.4$

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO 10
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 11-18-65

22,500 DWT

LOADED		KG	
LIGHT SHIP	21,029	19.2	
LOAD	49,070	22.2	
△	70,099	21.3	1,493,110.

KM = 32.3
KG = 21.3
GM = 11.0

KM_L = 481.3
KG = 21.3
GM_L = 460.0

BALLAST

LIGHT SHIP	21,029	19.2	
BALLAST	14,020	22.2	
	35,049	20.4	715,000

KM = 35.5
KG = 20.4
GM = 15.1

KM_L = 505.4
KG = 20.4
GM_L = 485.0

LIGHT

KM = 42.0
KG = 19.2
GM = 22.8

KM_L = 577.6
KG = 19.2
GM_L = 558.4

46,000 DWT

LOADED		KG	
LIGHT SHIP	39,753	22.5	
LOAD	92,756	26.0	
	132,509	24.9	3,306,099

KM 39.9
KG = 24.9
GM = 15.0

KM_L = 614.9
KG = 24.9
GM_L = 590.0

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO 11
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 11-18-65

46,000 DWT
BALLAST

		KG	
LIGHT SHIP	39,753	22.5	
BALLAST	26,502	26.0	
	66,255	23.9	1,583,495

KM = 43.9
KG = 23.9
GM = 20.0

KM_L = 645.6
KG = 23.9
GM_L = 621.7

LIGHT

KM = 51.9
KG = 28.5
GM = 29.4

KM_L = 737.9
KG = 22.5
GM_L = 715.4

70,000 DWT
LOADED

		KG	
LIGHT SHIP	61,495	27.0	
LOAD	143,790	31.2	
	209,985	29.9	6,137,253

KM 45.9
KG = 29.9
GM 16.0

KML 699.9
KG = 29.9
GM_L = 670.0

BALLAST

LIGHT SHIP	61,495	27.6	
BALLAST	40,998	31.2	
	102,493	28.7	2,939,503

KM = 50.5
KG. 28.7
GM 21.8

KM_L = 734.9
KG 28.7
GM_L 706.2

LIGHT

KM = 59.7
KG = 27.0
GM = 32.0

KM_L = 839.9
KG = 27.0
GM_L = 812.9

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO 12
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 11-18-65

22,500 DWT

LOADED

$$T_H = \frac{6.28}{\sqrt{\frac{32.2 \times 2,409}{131,545}}} = \frac{6.28}{\sqrt{0.5897}} = \frac{6.28}{0.77} = 8.2 \text{ SEC}$$

BALLAST

$$T_H = \frac{6.28}{\sqrt{\frac{32.2 \times 2,341}{92,846}}} = \frac{6.28}{\sqrt{0.8119}} = \frac{6.28}{0.90} = 7.0 \text{ SEC}$$

LIGHT

$$T_H = \frac{6.28}{\sqrt{\frac{32.2 \times 2,296}{74,513}}} = \frac{6.28}{\sqrt{0.9706}} = \frac{6.28}{0.99} = 6.3 \text{ SEC}$$

46,000 DWT

LOADED

$$T_H = \frac{6.28}{\sqrt{\frac{32.2 \times 3,904}{261,986}}} = \frac{6.28}{\sqrt{0.4798}} = \frac{6.28}{0.69} = 9.1 \text{ SEC}$$

BALLAST

$$T_H = \frac{6.28}{\sqrt{\frac{32.2 \times 3,806}{190,103}}} = \frac{6.28}{\sqrt{0.6497}} = \frac{6.28}{0.80} = 7.9 \text{ SEC}$$

LIGHT

$$T_H = \frac{6.28}{\sqrt{\frac{32.2 \times 3,665}{159,218}}} = \frac{6.28}{\sqrt{0.7652}} = \frac{6.28}{0.87} = 7.2 \text{ SEC}$$

~~LIGHT~~ 70,000 DWT LOADED

$$T_H = \frac{6.28}{\sqrt{\frac{32.2 \times 3,113}{400,116}}} = \frac{6.28}{\sqrt{0.4155}} = \frac{6.28}{0.64} = 9.8 \text{ SEC}$$

BALLAST $T_H = \frac{6.28}{\sqrt{\frac{32.2 \times 5,027}{286,474}}} = \frac{6.28}{\sqrt{0.5650}} = \frac{6.28}{0.75} = 8.4 \text{ SEC}$

LIGHT $T_H = \frac{6.28}{\sqrt{\frac{32.2 \times 4,842}{231,538}}} = \frac{6.28}{\sqrt{0.6734}} = \frac{6.28}{0.82} = 7.7 \text{ SEC}$

22,500 DWT

LOADED

$T_R = \frac{1.108 \times 29.8}{\sqrt{11.0}} = \frac{33.02}{3.22} = 10.2$ SEC

$T_P = \frac{1.108 \times 192.8}{\sqrt{460.0}} = \frac{213.62}{21.45} = 10.0$ SEC

BALLAST

$T_R = \frac{1.108 \times 32.8}{\sqrt{15.1}} = \frac{36.34}{3.89} = 9.3$ SEC

$T_P = \frac{1.108 \times 205.9}{\sqrt{485.0}} = \frac{228.14}{22.03} = 10.4$ SEC

LIGHT

$T_R = \frac{1.108 \times 34.9}{\sqrt{22.8}} = \frac{38.67}{4.78} = 8.1$ SEC

$T_P = \frac{1.108 \times 214.3}{\sqrt{558.4}} = \frac{237.44}{23.64} = 10.0$ SEC

46,000 DWT

LOADED

$T_R = \frac{1.108 \times 38.1}{\sqrt{15.0}} = \frac{42.21}{3.87} = 10.9$ SEC

$T_P = \frac{1.108 \times 240.5}{\sqrt{590.0}} = \frac{266.47}{24.30} = 11.0$ SEC

BALLAST

$T_R = \frac{1.108 \times 44.4}{\sqrt{20.0}} = \frac{49.20}{4.47} = 11.0$ SEC

$T_P = \frac{1.108 \times 256.0}{\sqrt{621.7}} = \frac{283.65}{25.95} = 10.9$ SEC

LIGHT

$T_R = \frac{1.108 \times 46.8}{\sqrt{29.4}} = \frac{51.85}{5.42} = 9.6$ SEC

$T_P = \frac{1.108 \times 265.6}{\sqrt{715.4}} = \frac{294.28}{26.75} = 11.0$ SEC

70,000 DWT
LOADED

$T_R = \frac{1.108 \times 43.3}{\sqrt{16.0}} = \frac{47.98}{4.00} = 12.0$ SEC

$T_P = \frac{1.108 \times 280.6}{\sqrt{670.0}} = \frac{310.90}{25.90} = 12.0$ SEC

BALLAST

$T_R = \frac{1.108 \times 43.7}{\sqrt{21.8}} = \frac{55.07}{4.67} = 11.8$ SEC

$T_P = \frac{1.108 \times 298.9}{\sqrt{706.7}} = \frac{331.18}{26.58} = 12.5$ SEC

LIGHT

$T_R = \frac{1.108 \times 52.6}{\sqrt{32.0}} = \frac{58.28}{5.66} = 10.3$ SEC

$T_P = \frac{1.108 \times 310.4}{\sqrt{812.9}} = \frac{343.92}{28.51} = 12.1$ SEC

22,500 DWT SEE SHEETS 28 & 29
LOADED

$T_{SURGE} = \frac{6.28}{\sqrt{\frac{32.2 \times}{4.766}}} = \frac{6.28}{\sqrt{\quad}} = \frac{6.28}{\quad} =$

$T_{SWAY} = \frac{6.28}{\sqrt{\frac{32.2 \times}{30,549}}} = \frac{6.28}{\sqrt{\quad}} = \frac{6.28}{\quad} =$

BALLAST

$T_{SURGE} = \frac{6.28}{\sqrt{\frac{32.2 \times}{2,618}}} = \frac{6.28}{\sqrt{\quad}} = \frac{6.28}{\quad} =$

$T_{SWAY} = \frac{6.28}{\sqrt{\frac{32.2 \times}{3,219}}} = \frac{6.28}{\sqrt{\quad}} = \frac{6.28}{\quad} =$

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY MCDERMOTT & CO., INC.

COMPANY			SHEET NO 15
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 11-19-65

22,500 DWT SEE SHEET 28 of 29

LIGHT

$$T_{SURGE} = \frac{6.28}{\sqrt{\frac{32.2}{1.662}}} = \frac{6.28}{\sqrt{\quad}} = \frac{6.28}{\quad} =$$

$$T_{SWAY} = \frac{6.28}{\sqrt{\frac{32.2}{3.916}}} = \frac{6.28}{\sqrt{\quad}} = \frac{6.28}{\quad} =$$

46,000 DWT

LOADED

$$T_{SURGE} = \frac{6.28}{\sqrt{\frac{32.2}{8.082}}} = \frac{6.28}{\sqrt{\quad}} = \frac{6.28}{\quad} =$$

$$T_{SWAY} = \frac{6.28}{\sqrt{\frac{32.2}{51.437}}} = \frac{6.28}{\sqrt{\quad}} = \frac{6.28}{\quad} =$$

BALLAST

$$T_{SURGE} = \frac{6.28}{\sqrt{\frac{32.2}{4.447}}} = \frac{6.28}{\sqrt{\quad}} = \frac{6.28}{\quad} =$$

$$T_{SWAY} = \frac{6.28}{\sqrt{\frac{32.2}{15.574}}} = \frac{6.28}{\sqrt{\quad}} = \frac{6.28}{\quad} =$$

LIGHT

$$T_{SURGE} = \frac{6.28}{\sqrt{\frac{32.2}{2.822}}} = \frac{6.28}{\sqrt{\quad}} = \frac{6.28}{\quad} =$$

$$T_{SWAY} = \frac{6.28}{\sqrt{\frac{32.2}{6.271}}} = \frac{6.28}{\sqrt{\quad}} = \frac{6.28}{\quad} =$$

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO. 16
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 11-19-65

70,000 DWT SEE SHEETS 28 & 29

LOADED

$T_{SURGE} = \frac{6.28}{\sqrt{\frac{32.2 \times}{14,441}}} = \frac{6.28}{\sqrt{\quad}} = 6.28$

$T_{SWAY} = \frac{6.28}{\sqrt{\frac{32.2 \times}{81,699}}} = \frac{6.28}{\sqrt{\quad}} = 6.28$

BALLAST

$T_{SURGE} = \frac{6.28}{\sqrt{\frac{32.2 \times}{7,947}}} = \frac{6.28}{\sqrt{\quad}} = 6.28$

$T_{SWAY} = \frac{6.28}{\sqrt{\frac{32.2 \times}{24,712}}} = \frac{6.28}{\sqrt{\quad}} = 6.28$

LIGHT

$T_{SURGE} = \frac{6.28}{\sqrt{\frac{32.2 \times}{5,054}}} = \frac{6.28}{\sqrt{\quad}} = 6.28$

$T_{SWAY} = \frac{6.28}{\sqrt{\frac{32.2 \times}{10,010}}} = \frac{6.28}{\sqrt{\quad}} = 6.28$

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

$T_Y = \frac{1.108 \times K}{\sqrt{K_{FT} \times \ell}}$

COMPANY	SHEET NO 17
SUBJECT	
DRAWING NUMBER / COMPUTER / CHECKED BY	DATE 11-19-65

22,500 DWT SEE SHEETS 30 & 31

LOADED

$T_{YAW} = \frac{1.108 \times 192.8}{\sqrt{70,099}} = \frac{213.62}{\sqrt{\ }} = 213.62$

BALLAST

$T_{YAW} = \frac{1.108 \times 205.9}{\sqrt{35,099}} = \frac{228.14}{\sqrt{\ }} = 228.14$

LIGHT

$T_{YAW} = \frac{1.108 \times 214.3}{\sqrt{21,029}} = \frac{237.44}{\sqrt{\ }} = 237.44$

46,000 DWT

LOADED

$T_{YAW} = \frac{1.108 \times 240.5}{\sqrt{132,509}} = \frac{266.47}{\sqrt{\ }} = 266.47$

BALLAST $= \frac{1.108 \times 256.0}{\sqrt{66,255}} = \frac{283.65}{\sqrt{\ }} = 283.65$

LIGHT $= \frac{1.108 \times 265.6}{\sqrt{32,753}} = \frac{294.28}{\sqrt{\ }} = 294.28$

70,000 DWT

LOADED

$T_{YAW} = \frac{1.108 \times 280.6}{\sqrt{209,385}} = \frac{310.90}{\sqrt{\ }} = 310.90$

BALLAST

$T_{YAW} = \frac{1.108 \times 298.9}{\sqrt{102,993}} = \frac{331.18}{\sqrt{\ }} = 331.18$

LIGHT

$T_{YAW} = \frac{1.108 \times 310.9}{\sqrt{61,499}} = \frac{343.92}{\sqrt{\ }} = 343.92$

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MED 5015

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO 18
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 11-19-65

$\lambda = 5.118 \times T_w^2$

θ RAD $= \frac{\pi H}{\lambda}$

HEAD SEA

T_w	λ	H/L 22,500 DWT	$\pi H/\lambda$	H/L 46,000 DWT	$\pi H/\lambda$	H/L 70,000 DWT	$\pi H/\lambda$
6	184'	0.32	9.81	0.26	12.08	0.22	14.27
7	251'	0.43	7.30	0.35	8.97	0.30	10.47
8	328'	0.57	5.51	0.46	6.83	0.39	8.05
9	415'	0.72	4.36	0.58	5.41	0.49	6.41
10	512'	0.88	3.57	0.71	4.42	0.61	5.15
11	619'	1.07	2.93	0.86	3.65	0.74	4.24
12	737'	1.27	2.47	1.03	3.05	0.88	3.57
13	865'	1.49	2.11	1.20	2.62	1.03	3.05

10° BOW SEA

T_w	λ	H/L 22,500 DWT	$\pi H/\lambda$	H/L 46,000 DWT	$\pi H/\lambda$	H/L 70,000 DWT	$\pi H/\lambda$
6	187	0.32	9.81	0.26	12.08	0.22	14.27
7	255	0.44	7.14	0.35	8.97	0.30	10.47
8	333	0.57	5.51	0.46	6.83	0.40	7.85
9	421	0.72	4.36	0.59	5.32	0.50	6.28
10	520	0.89	3.53	0.72	4.36	0.62	5.06
11	629	1.08	2.91	0.87	3.61	0.75	4.19
12	748	1.29	2.43	1.04	3.02	0.89	3.53
13	878	1.51	2.08	1.22	2.57	1.04	3.02

20° BOW SEA

T_w	λ	H/L 22,500 DWT	$\pi H/\lambda$	H/L 46,000 DWT	$\pi H/\lambda$	H/L 70,000 DWT	$\pi H/\lambda$
6	196	0.34	9.24	0.27	11.63	0.23	13.65
7	267	0.46	6.83	0.37	8.49	0.32	9.81
8	349	0.60	5.23	0.49	6.41	0.42	7.48
9	442	0.76	4.13	0.61	5.15	0.53	5.92
10	545	0.94	3.34	0.76	4.13	0.65	4.83
11	659	1.13	2.78	0.92	3.41	0.78	4.03
12	784	1.35	2.33	1.09	2.88	0.93	3.38
13	921	1.58	1.99	1.28	2.45	1.10	2.85

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 5015

J. RAY McDERMOTT & CO., INC.

COMPANY | SHEET NO 19

SUBJECT

DRAWING NUMBER | COMPUTER | CHECKED BY | DATE 11-19-65

30° Bow Sea

T_w	λ	$\frac{H}{L}$ 22,500 DWT	$\frac{H}{\lambda}$	$\frac{H}{L}$ 46,000 DWT	$\frac{H}{\lambda}$	$\frac{H}{L}$ 120,000 DWT	$\frac{H}{\lambda}$
6	212	0.36	8.72	0.29	10.83	0.25	12.56
7	290	0.50	6.26	0.40	7.85	0.35	8.97
8	379	0.65	4.83	0.53	5.92	0.45	6.98
9	479	0.82	3.83	0.67	4.69	0.57	5.51
10	591	1.02	3.08	0.82	3.83	0.70	4.43
11	715	1.23	2.55	0.99	3.17	0.85	3.69
12	851	1.46	2.15	1.18	2.66	1.01	3.11
13	999	1.72	1.83	1.39	2.26	1.19	2.69

For Roll

T_w	10° λ	20° λ	30° λ
6	1,058	537	368
7	1,443	733	502
8	1.886	958	656
9	2,386	1,212	830
10	2,944	1,495	1024
11	3,559	1,807	1,238
12	4,238	2,152	1,474
13	4,934	2,526	1,730

For Roll 10' Wave

T_w	10° ζ	20° ζ	30° ζ
6	0.0297	0.0585	0.0853
7	0.0218	0.0428	0.0625
8	0.0166	0.0328	0.0479
9	0.0132	0.0259	0.0378
10	0.0107	0.0210	0.0307
11	0.0088	0.0174	0.0254
12	0.0074	0.0146	0.0213
13	0.0064	0.0124	0.0182

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY MCDERMOTT & CO., INC.

COMPANY | SHEET NO. 20

SUBJECT

DRAWING NUMBER | COMPUTER | CHECKED BY | DATE 11-19-65

HEAD SEA

T_W	22,500 DWT $\Sigma z(\delta)$	$\Sigma\Psi$	C_{mP}	C_{mR}	46,000 DWT $\Sigma z(\delta)$	$\Sigma\Psi$	C_{mP}	C_{mR}	70,000 DWT $\Sigma z(\delta)$	$\Sigma\Psi$	C_{mP}	C_{mR}
6	0.00	0.00	0.1707		0.00	0.00	0.1707		0.00	0.00	0.1707	
7	0.00	0.00	0.1251		0.00	0.00	0.1251		0.00	0.00	0.1251	
8	0.00	0.00	0.0957		0.00	0.00	0.0957		0.00	0.00	0.0957	
9	0.03	0.12	0.0757	0.0	0.00	0.01	0.0757	0.0	0.00	0.00	0.0757	0.0
10	0.17	0.27	0.0613		0.02	0.10	0.0613		0.00	0.02	0.0613	
11	0.33	0.41	0.0507		0.14	0.23	0.0507		0.04	0.13	0.0507	
12	0.48	0.52	0.0426		0.25	0.38	0.0426		0.11	0.26	0.0426	
13	0.58	0.63	0.0363		0.43	0.49	0.0363		0.30	0.38	0.0363	

10° BOW SEA

T_W	22,500 DWT $\Sigma z(\delta)$	$\Sigma\Psi$	C_{mP}	C_{mR}	46,000 DWT $\Sigma z(\delta)$	$\Sigma\Psi$	C_{mP}	C_{mR}	70,000 DWT $\Sigma z(\delta)$	$\Sigma\Psi$	C_{mP}	C_{mR}
6	0.00	0.00	0.1679	0.0297	0.00	0.00	0.1679	0.0297	0.00	0.00	0.1679	0.0297
7	0.00	0.00	0.1231	0.0218	0.00	0.00	0.1231	0.0218	0.00	0.00	0.1231	0.0218
8	0.00	0.00	0.0943	0.0166	0.00	0.00	0.0943	0.0166	0.00	0.00	0.0943	0.0166
9	0.03	0.12	0.0746	0.0132	0.00	0.01	0.0746	0.0132	0.00	0.00	0.0746	0.0132
10	0.17	0.27	0.0604	0.0107	0.03	0.11	0.0604	0.0107	0.00	0.02	0.0604	0.0107
11	0.34	0.42	0.0499	0.0088	0.15	0.25	0.0499	0.0088	0.05	0.13	0.0499	0.0088
12	0.48	0.54	0.0420	0.0074	0.31	0.38	0.0420	0.0074	0.17	0.27	0.0420	0.0074
13	0.58	0.64	0.0358	0.0064	0.45	0.52	0.0358	0.0064	0.31	0.38	0.0358	0.0064

20° BOW SEA

T_W	22,500 DWT $\Sigma z(\delta)$	$\Sigma\Psi$	C_{mP}	C_{mR}	46,000 DWT $\Sigma z(\delta)$	$\Sigma\Psi$	C_{mP}	C_{mR}	70,000 DWT $\Sigma z(\delta)$	$\Sigma\Psi$	C_{mP}	C_{mR}
6	0.00	0.00	0.1602	0.0285	0.00	0.00	0.1602	0.0285	0.00	0.00	0.1602	0.0285
7	0.00	0.00	0.1176	0.0428	0.00	0.00	0.1176	0.0428	0.00	0.00	0.1176	0.0428
8	0.00	0.01	0.0900	0.0328	0.00	0.00	0.0900	0.0328	0.00	0.00	0.0900	0.0328
9	0.05	0.15	0.0710	0.0259	0.00	0.02	0.0710	0.0259	0.00	0.00	0.0710	0.0259
10	0.22	0.31	0.0576	0.0210	0.05	0.15	0.0576	0.0210	0.01	0.05	0.0576	0.0210
11	0.38	0.45	0.0476	0.0174	0.20	0.29	0.0476	0.0174	0.06	0.17	0.0476	0.0174
12	0.51	0.57	0.0401	0.0146	0.35	0.43	0.0401	0.0146	0.22	0.30	0.0401	0.0146
13	0.62	0.66	0.0341	0.0124	0.48	0.53	0.0341	0.0124	0.36	0.43	0.0341	0.0124

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY MCDERMOTT & CO., INC.

COMPANY | SHEET NO 21

SUBJECT

DRAWING NUMBER | COMPUTER | CHECKED BY | DATE 11-22-65

30° Bow Sea

Tw	22,500 DWT				46,000 DWT				70,000 DWT			
	Σz	$\Sigma 4$	C_{mp}	C_{mR}	Σz	$\Sigma 4$	C_{mp}	C_{mR}	Σz	$\Sigma 4$	C_{mp}	C_{mR}
6	0.00	0.00	0.1481	0.0853	0.00	0.00	0.1481	0.0853	0.00	0.00	0.1481	0.0853
7	0.00	-0.00	0.1083	0.0625	0.00	0.00	0.1083	0.0625	0.00	0.00	0.1083	0.0625
8	0.01	0.05	0.0828	0.0479	0.00	0.00	0.0828	0.0479	0.00	0.00	0.0828	0.0479
9	0.10	0.20	0.0656	0.0378	0.01	0.07	0.0656	0.0378	0.00	0.00	0.0656	0.0378
10	0.30	0.38	0.0531	0.0307	0.10	0.20	0.0531	0.0307	0.02	0.08	0.0531	0.0307
11	0.45	0.51	0.0439	0.0254	0.27	0.36	0.0439	0.0254	0.13	0.23	0.0439	0.0254
12	0.57	0.62	0.0369	0.0213	0.42	0.48	0.0369	0.0213	0.28	0.37	0.0369	0.0213
13	0.65	0.68	0.0314	0.0182	0.53	0.59	0.0314	0.0182	0.42	0.48	0.0314	0.0182

M 22,500 DWT LOADED

Tw	Λ	M_Z	Λ	M_4	Λ	M_4	Λ	M_X	Λ	M_Y	Λ	M_Θ
6	1.27	1.13	1.70	0.60	1.67	0.60	1.85	0.5	16.18	0.03		
7	1.17	1.70	1.46	0.9	1.43	1.0	1.59	0.7	13.87	0.04		
8	1.03	2.0	1.28	1.5	1.25	1.6	1.39	1.0	12.14	0.04		
9	0.91	2.2	1.13	2.8	1.11	2.2	1.23	1.7	10.79	0.05		
10	0.82	2.0	1.02	5.0	1.00	2.7	1.11	2.6	9.71	0.05		
11	0.75	1.8	0.93	4.6	0.91	2.7	1.01	3.4	8.83	0.06		
12	0.68	1.7	0.85	3.2	0.83	2.3	0.93	3.4	8.09	0.07		
13	0.63	1.6	0.78	2.5	0.77	2.0	0.85	2.8	7.47	0.07		

M 22,500 DWT BALLAST

	Λ	M_Z	Λ	M_4	Λ	M_4	Λ	M_X	Λ	M_Y	Λ	M_Θ
6	1.17	1.7	1.55	0.8	1.73	0.6	1.37	1.1	14.52	0.04		
7	1.00	2.2	1.33	1.3	1.49	0.8	1.17	1.9	12.44	0.04		
8	0.88	2.2	1.16	2.5	1.30	1.3	1.03	3.3	10.88	0.05		
9	0.78	1.9	1.03	4.6	1.16	2.0	0.91	3.2	9.68	0.05		
10	0.70	1.7	0.93	4.6	1.04	2.5	0.82	2.5	8.76	0.06		
11	0.64	1.6	0.85	3.2	0.95	2.7	0.75	2.2	7.92	0.07		
12	0.58	1.5	0.78	2.5	0.87	2.5	0.68	1.8	7.26	0.07		
13	0.54	1.3	0.72	2.0	0.80	2.2	0.63	1.7	6.70	0.08		

DAMPING COEFFICIENT $K_{HEAVE} = 0.5$ $K_{SURGE} = 0.3$
$K_{ROLL} = 0.2$ $K_{SWAY} = 0.5$
$K_{PITCH} = 0.4$ $K_{YAW} = 0.4$

SECTION II

MOTION STUDY EQUATIONS

AND

COMPUTER OUTPUTS

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO
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$$AH = \boxed{H/2 \times \Sigma_z(\delta) \times M}$$

$$AP = V_{mP} \times \Sigma \Psi(\delta) \times M = \boxed{\frac{2\pi^2 H \cos\chi \, \Sigma H(\delta) M}{g (T_w)^2}}$$

$$AR = V_{mR} \times M = \boxed{\frac{2\pi^2 H \sin\chi \, M}{g (T_w)^2}}$$

$$ASU = \frac{V_{mP} \times \Sigma \Psi(\delta) \times \Delta \times (T_w)^2}{M_{VSU} \times (2\pi)^2} = \frac{2\pi^2 H \cos\chi}{g (T_w)^2} \times \frac{\Sigma \Psi(\delta) \times \Delta \times (T_w)^2}{M_{VSU} \times (2\pi)^2} =$$

$$= \boxed{\frac{H \cos\chi \, \Delta \, \Sigma \Psi(\delta)}{2g \, M_{VSU}}}$$

$$ASW = \frac{V_{mR} \times \Sigma \Psi(\delta) \times \Delta \times (T_w)^2}{M_{VSW} \times (2\pi)^2} = \frac{2\pi^2 H \sin\chi \, \Sigma \Psi(\delta) \times \Delta \times (T_w)^2}{g (T_w)^2 \, M_{VSW} \times (2\pi)^2}$$

$$= \boxed{\frac{H \sin\chi \, \Sigma \Psi(\delta) \Delta}{2g \, M_{VSW}}}$$

$$AY = \frac{V_{mR} \, \Delta \times 4/4 \times (T_w)^2}{J \times (2\pi)^2} = \frac{2\pi^2 H \sin\chi}{g (T_w)^2} \times \frac{\Delta \times 4/4 \times (T_w)^2}{J \times (2\pi)^2}$$

$$= \boxed{\frac{H \sin\chi \, \Delta \, 4/4}{2g \, J}}$$

MOTION EQUATIONS FOR MOTION STUDY

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY MCDERMOTT & CO., INC.

COMPANY			SHEET NO
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 12-7-65

22,500 DWT TANKER

L = 579.2 LOADED B = 77.0 Δ_{LOADED} = 70,039 Δ_{LIGHT} = 21,029

LOADED	LIGHT
TSH = 8.2	TSH = 6.3
TSP = 10.0	TSP = 10.0
TSR = 10.2	TSR = 8.1
MSU = 2,325	MSU = 705
MSW = 3,126	MSW = 768
~~TSJ~~ = 107,849,965	~~J~~ = 35,291,980

$\chi = 0$		$\chi = 10$		$\chi = 20$		$\chi = 30$	
$\Sigma_z(\delta)$	$\Sigma_\psi(\delta)$	$\Sigma_z(\delta)$	$\Sigma_\psi(\delta)$	$\Sigma_z(\delta)$	$\Sigma_\psi(\delta)$	$\Sigma_z(\delta)$	$\Sigma_\psi(\delta)$
6 0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7 0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8 0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.05
9 0.03	0.12	0.03	0.12	0.05	0.15	0.10	0.20
10 0.17	0.27	0.17	0.27	0.22	0.31	0.30	0.38
11 0.33	0.41	0.34	0.42	0.38	0.45	0.45	0.51
12 0.48	0.52	0.48	0.54	0.51	0.57	0.57	0.62
13 0.58	0.63	0.58	0.64	0.62	0.66	0.65	0.68
S	G	S	G	S	G	S	G

COMPUTER INPUT FOR MOTION STUDY

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO.
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 12-7-65

70,000 DWT TANKER

$L = 831.9$ $B = 102$ $\Delta_{LOADED} = 209,985$ $\Delta_{LIGHT} = 61,495$

LOADED		LIGHT	
TSH =	9.8	TSH =	7.7
TSP =	12.0	TSP =	12.1
TSR =	12.0	TSR =	10.3
MSU =	6,815	MSU =	2,067
MSW =	8,903	MSW =	2,221
J =	639,019,271	J =	214,029,680

	$\chi = 0$		$\chi = 10$		$\chi = 20$		$\chi = 30$	
	$\Sigma_2(\delta)$	$\Sigma\Psi(\delta)$	$\Sigma_2(\delta)$	$\Sigma\Psi(\delta)$	$\Sigma_2(\delta)$	$\Sigma\Psi(\delta)$	$\Sigma_2(\delta)$	$\Sigma\Psi(\delta)$
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.02	0.00	0.02	0.01	0.05	0.02	0.08
11	0.04	0.13	0.05	0.13	0.06	0.17	0.13	0.23
12	0.17	0.26	0.17	0.27	0.22	0.30	0.28	0.37
13	0.30	0.38	0.31	0.38	0.36	0.43	0.42	0.48
	S	G	S	G	S	G	S	G

COMPUTER INPUT FOR MOTION STUDY

DEAD WEIGHT TONNAGE = 22500.

LENGTH = 579.20 FT.

BEAM = 77.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 0.00 DEGREES

WAVE PERIOD = 0.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.03	.12					
P1 = 2.17120	R1 = 2.81917	AH1 = 2.26014				
0.00	-.39	0.00	7.90	1.12	0.00	0.00
30.00	-.54	0.00	7.23	1.12	0.00	0.00
60.00	-.54	0.00	4.63	1.12	0.00	0.00
90.00	-.39	0.00	.78	1.12	0.00	0.00
120.00	-.14	0.00	-3.27	1.12	0.00	0.00
150.00	.14	0.00	-6.45	1.12	0.00	0.00
.17	.27					

DEAD WEIGHT TONNAGE = 22500.

LENGTH = 579.20 FT.

BEAM = 77.00 FT.

DRAFT CONDITION - LIGHT

HEADING ANGLE = 0.00 DEGREES

WAVE PERIOD = 9.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.03	.12					
P1 = 2.17120	R1 = 3.88220		AH1 = 1.71285			
0.00	-.39	0.00	7.91	1.12	0.00	0.00
30.00	-.53	0.00	7.15	1.12	0.00	0.00
60.00	-.53	0.00	4.48	1.12	0.00	0.00
90.00	-.39	0.00	.61	1.12	0.00	0.00
120.00	-.14	0.00	-3.42	1.12	0.00	0.00
150.00	.14	0.00	-6.54	1.12	0.00	0.00
.17	.27					

DEAD WEIGHT TONNAGE = 22500.

LENGTH = 579.20 FT.

BEAM = 77.00 FT.

DRAFT CONDITION - LIGHT

HEADING ANGLE = 0.00 DEGREES

WAVE PERIOD = 11.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.33	.41					
P1 = 2.64362	R1 = 2.10197		AH1 = 1.42403			
0.00	-1.34	0.00	-12.72	3.14	0.00	0.00
30.00	-1.83	0.00	-3.27	3.14	0.00	0.00
60.00	-1.83	0.00	7.05	3.14	0.00	0.00
90.00	-1.34	0.00	15.49	3.14	0.00	0.00
120.00	-.49	0.00	19.77	3.14	0.00	0.00
150.00	.49	0.00	18.76	3.14	0.00	0.00
.03	.12					

DEAD WEIGHT TONNAGE = 22500.

LENGTH = 579.20 FT.

BEAM = 77.00 FT.

DRAFT CONDITION - LIGHT

HEADING ANGLE = 10.00 DEGREES

WAVE PERIOD = 10.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.17	.27					
P1 = 2.69023	R1 = 2.66486	AH1 = 1.54089				
0.00	-.87	-.16	9.84	2.51	1.62	-.01
30.00	-1.19	-.19	7.41	2.51	1.62	-.01
60.00	-1.18	-.17	3.00	2.51	1.62	-.01
90.00	-.86	-.11	-2.21	2.51	1.62	-.01
120.00	-.31	-.01	-6.84	2.51	1.62	-.01
150.00	.32	.08	-9.63	2.51	1.62	-.01
.34	.42					

DEAD WEIGHT TONNAGE = 22500.

LENGTH = 579.20 FT.

BEAM = 77.00 FT.

DRAFT CONDITION - LIGHT

HEADING ANGLE = 10.00 DEGREES

WAVE PERIOD = 11.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.34	.42					
P1 = 2.64362	R1 = 2.10197		AH1 = 1.42403			
0.00	-1.35	-.26	-6.18	3.17	1.05	-.01
30.00	-1.85	-.30	-.57	3.17	1.05	-.01
60.00	-1.84	-.26	5.18	3.17	1.05	-.01
90.00	-1.34	-.15	9.55	3.17	1.05	-.01
120.00	-.48	0.00	11.36	3.17	1.05	-.01
150.00	.50	.14	10.12	3.17	1.05	-.01
.05	.15					

DEAD WEIGHT TONNAGE = 22500.

LENGTH = 579.20 FT.

BEAM = 77.00 FT.

DRAFT CONDITION - LIGHT

HEADING ANGLE = 20.00 DEGREES

WAVE PERIOD = 9.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.05	.15					

P1 = 2.17120 R1 = 3.88220 AH1 = 1.71285

0.00	-.46	-.17	1.63	1.32	5.75	-.02
30.00	-.63	-.21	3.21	1.32	5.75	-.02
60.00	-.62	-.19	3.92	1.32	5.75	-.02
90.00	-.45	-.12	3.58	1.32	5.75	-.02
120.00	-.15	-.02	2.28	1.32	5.75	-.02
150.00	.18	.08	.37	1.32	5.75	-.02
.22	.31					

DEAD WEIGHT TONNAGE = 22500.

LENGTH = 579.20 FT.

BEAM = 77.00 FT.

DRAFT CONDITION - LIGHT

HEADING ANGLE = 20.00 DEGREES

WAVE PERIOD = 10.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.22	.31					

P1 = 2.69023 R1 = 2.66486 AH1 = 1.54089

0.00	-.96	-.38	7.54	2.75	3.20	-.02
30.00	-1.30	-.44	6.44	2.75	3.20	-.02
60.00	-1.29	-.37	3.50	2.75	3.20	-.02
90.00	-.94	-.21	-.18	2.75	3.20	-.02
120.00	-.33	0.00	-3.93	2.75	3.20	-.02
150.00	.36	.22	-6.62	2.75	3.20	-.02
.38	.45					

DEAD WEIGHT TONNAGE = 22500.

LENGTH = 579.20 FT.

BEAM = 77.00 FT.

DRAFT CONDITION - LIGHT

HEADING ANGLE = 20.00 DEGREES

WAVE PERIOD = 11.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.38	.45					
P1 = 2.64362	R1 = 2.10197		AH1 = 1.42403			
0.00	-1.39	-.57	-3.31	3.24	2.08	-.02
30.00	-1.89	-.64	.90	3.24	2.08	-.02
60.00	-1.88	-.54	4.37	3.24	2.08	-.02
90.00	-1.37	-.29	7.54	3.24	2.08	-.02
120.00	-.48	.03	8.19	3.24	2.08	-.02
150.00	.52	.34	6.64	3.24	2.08	-.02
.10	.20					

DEAD WEIGHT TONNAGE = 22500.

LENGTH = 579.20 FT.

BEAM = 77.00 FT.

DRAFT CONDITION - LIGHT

HEADING ANGLE = 30.00 DEGREES

WAVE PERIOD = 9.00 SECONDS

WAVE ANGLE (DEG) .10 .20	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
P1 = 2.17120	R1 = 3.88220	AH1 = 1.71285				
0.00 .30	-.57 .38	-.37	-.21	1.63	8.41	-.03
30.00	-.77	-.41	2.36	1.63	8.41	-.03
60.00	-.76	-.35	4.30	1.63	8.41	-.03
90.00	-.65	-.18	5.10	1.63	8.41	-.03
120.00	-.18	.02	4.52	1.63	8.41	-.03
150.00	.22	.22	2.73	1.63	8.41	-.03

DEAD WEIGHT TONNAGE = 22500.

LENGTH = 579.20 FT.

BEAM = 77.00 FT.

DRAFT CONDITION - LIGHT

HEADING ANGLE = 30.00 DEGREES

WAVE PERIOD = 10.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.30	.38					
P1 = 2.69023	R1 = 2.66486		AH1 = 1.54089			
0.00	-1.09	-.72	5.06	3.10	4.67	-.03
30.00	-1.47	-.79	5.37	3.10	4.67	-.03
60.00	-1.46	-.65	4.25	3.10	4.67	-.03
90.00	-1.05	-.33	1.98	3.10	4.67	-.03
120.00	-.37	.07	-.81	3.10	4.67	-.03
150.00	.41	.46	-3.39	3.10	4.67	-.03
.45	.51					

DEAD WEIGHT TONNAGE = 22500.

LENGTH = 579.20 FT.

BEAM = 77.00 FT.

DRAFT CONDITION - LIGHT

HEADING ANGLE = 30.00 DEGREES

WAVE PERIOD = 11.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.45	.51					
P1 = 2.64362	R1 = 2.10197	AH1 = 1.42403				
0.00	-1.46	-.98	-.17	3.38	3.05	-.03
30.00	-1.97	-1.06	2.58	3.38	3.05	-.03
60.00	-1.96	-.87	4.64	3.38	3.05	-.03
90.00	-1.42	-.43	5.46	3.38	3.05	-.03
120.00	-.50	.11	4.81	3.38	3.05	-.03
150.00	.55	.63	2.87	3.38	3.05	-.03

DEAD WEIGHT TONNAGE = 22500.

LENGTH = 579.20 FT.

BEAM = 77.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 0.00 DEGREES

WAVE PERIOD = 9.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.03	.12					
P1 = 2.17120	R1 = 2.81917	AH1 = 2.26014				
0.00	-.39	0.00	7.90	1.12	0.00	0.00
30.00	-.54	0.00	7.23	1.12	0.00	0.00
60.00	-.54	0.00	4.63	1.12	0.00	0.00
90.00	-.39	0.00	.78	1.12	0.00	0.00
120.00	-.14	0.00	-3.27	1.12	0.00	0.00
150.00	.14	0.00	-6.45	1.12	0.00	0.00
.17	.27					

DEAD WEIGHT TONNAGE = 22500.

LENGTH = 579.20 FT.

BEAM = 77.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 0.00 DEGREES

WAVE PERIOD = 10.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.17	.27					
P1 = 2.69023	R1 = 4.90760		AH1 = 2.05940			
0.00	-.89	0.00	17.66	2.55	0.00	0.00
30.00	-1.22	0.00	12.54	2.55	0.00	0.00
60.00	-1.22	0.00	4.05	2.55	0.00	0.00
90.00	-.89	0.00	-5.51	2.55	0.00	0.00
120.00	-.32	0.00	-13.61	2.55	0.00	0.00
150.00	.32	0.00	-18.05	2.55	0.00	0.00
.33	.41					

DEAD WEIGHT TONNAGE = 22500.

LENGTH = 579.20 FT.

BEAM = 77.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 0.00 DEGREES

WAVE PERIOD = 11.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.33	.41					
P1 = 2.64362	R1 = 4.37508	AH1 = 1.84021				
0.00	-1.35	0.00	-12.19	3.14	0.00	0.00
30.00	-1.85	0.00	-2.44	3.14	0.00	0.00
60.00	-1.85	0.00	7.94	3.14	0.00	0.00
90.00	-1.35	0.00	16.21	3.14	0.00	0.00
120.00	-.49	0.00	20.14	3.14	0.00	0.00
150.00	.49	0.00	18.66	3.14	0.00	0.00
.03	.12					

DEAD WEIGHT TONNAGE = 22500.

LENGTH = 579.20 FT.

BEAM = 77.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 10.00 DEGREES

WAVE PERIOD = 9.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.03	.12					

P1 = 2.17120 R1 = 2.81917 AH1 = 2.26014

0.00	-.39	-.04	5.56	1.11	2.12	-.01
30.00	-.53	-.06	5.53	1.11	2.12	-.01
60.00	-.53	-.07	4.01	1.11	2.12	-.01
90.00	-.38	-.06	1.43	1.11	2.12	-.01
120.00	-.13	-.03	-1.54	1.11	2.12	-.01
150.00	.15	0.00	-4.10	1.11	2.12	-.01
.17	.27					

DEAD WEIGHT TONNAGE = 22500.

LENGTH = 579.20 FT.

BEAM = 77.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 10.00 DEGREES

WAVE PERIOD = 10.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.17	.27					
P1 = 2.69023	R1 = 4.90760		AH1 = 2.05940			
0.00	-.88	-.12	12.40	2.51	2.99	-.01
30.00	-1.20	-.15	9.41	2.51	2.99	-.01
60.00	-1.19	-.14	3.89	2.51	2.99	-.01
90.00	-.87	-.10	-2.65	2.51	2.99	-.01
120.00	-.31	-.02	-8.50	2.51	2.99	-.01
150.00	.32	.05	-12.06	2.51	2.99	-.01
.34	.42					

DEAD WEIGHT TONNAGE = 22500.

LENGTH = 579.20 FT.

BEAM = 77.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 20.00 DEGREES

WAVE PERIOD = 9.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.05	.15					

P1 = 2.17120 R1 = 2.81917 AH1 = 2.26014

0.00	-.47	-.13	5.93	1.32	4.18	-.02
30.00	-.63	-.17	6.33	1.32	4.18	-.02
60.00	-.63	-.16	5.04	1.32	4.18	-.02
90.00	-.45	-.11	2.39	1.32	4.18	-.02
120.00	-.15	-.03	-.89	1.32	4.18	-.02
150.00	.18	.05	-3.94	1.32	4.18	-.02
.22	.31					

DEAD WEIGHT TONNAGE = 22500.

LENGTH = 579.20 FT.

BEAM = 77.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 20.00 DEGREES

WAVE PERIOD = 10.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.22	.31					
P1 = 2.69023	R1 = 4.90760		AH1 = 2.05940			
0.00	-.97	-.30	12.41	2.75	5.89	-.02
30.00	-1.31	-.36	10.01	2.75	5.89	-.02
60.00	-1.30	-.31	4.92	2.75	5.89	-.02
90.00	-.95	-.18	-1.47	2.75	5.89	-.02
120.00	-.33	0.00	-7.48	2.75	5.89	-.02
150.00	.36	.17	-11.48	2.75	5.89	-.02
.38	.45					

DEAD WEIGHT TONNAGE = 22500.

LENGTH = 579.20 FT.

BEAM = 77.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 20.00 DEGREES

WAVE PERIOD = 11.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.38	.45					
P1 = 2.64362	R1 = 4.37508		AH1 = 1.84021			
0.00	-1.41	-.39	-14.19	3.24	4.34	-.02
30.00	-1.91	-.51	-2.79	3.24	4.34	-.02
60.00	-1.90	-.50	9.35	3.24	4.34	-.02
90.00	-1.38	-.35	19.00	3.24	4.34	-.02
120.00	-.49	-.11	23.55	3.24	4.34	-.02
150.00	.52	.16	21.79	3.24	4.34	-.02

DEAD WEIGHT TONNAGE = 22500.

LENGTH = 579.20 FT.

BEAM = 77.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 30.00 DEGREES

WAVE PERIOD = 9.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.10	.20					

P1 = 2.17120 R1 = 2.91917 AH1 = 2.26014

0.00	-.58	-.30	6.05	1.63	6.11	-.03
30.00	-.78	-.34	7.00	1.63	6.11	-.03
60.00	-.77	-.29	6.07	1.63	6.11	-.03
90.00	-.55	-.16	3.51	1.63	6.11	-.03
120.00	-.18	0.00	.01	1.63	6.11	-.03
150.00	.23	.17	-3.49	1.63	6.11	-.03
.30	.38					

DEAD WEIGHT TONNAGE = 22500.

LENGTH = 579.20 FT.

BEAM = 77.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 30.00 DEGREES

WAVE PERIOD = 10.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.30	.38					
P1 = 2.69023	R1 = 4.90760	AH1 = 2.05940				
0.00	-1.10	-.58	12.14	3.10	8.61	-.03
30.00	-1.49	-.65	10.53	3.10	8.61	-.03
60.00	-1.47	-.53	6.09	3.10	8.61	-.03
90.00	-1.06	-.28	.02	3.10	8.61	-.03
120.00	-.37	.04	-6.05	3.10	8.61	-.03
150.00	.42	.36	-10.50	3.10	8.61	-.03
.45	.51					

DEAD WEIGHT TONNAGE = 22500.

LENGTH = 579.20 FT.

BEAM = 77.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 30.00 DEGREES

WAVE PERIOD = 11.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)**
.45	.51					
P1 = 2.64362	R1 = 4.37508		AH1 = 1.84021			
0.00	-1.47	-.79	-1.98	3.38	6.34	-.04
30.00	-1.99	-.87	2.06	3.38	6.34	-.04
60.00	-1.98	-.71	5.56	3.38	6.34	-.04
90.00	-1.43	-.36	7.57	3.38	6.34	-.04
120.00	-.50	.07	7.55	3.38	6.34	-.04
150.00	.55	.50	5.51	3.38	6.34	-.04
ER F7						
.03	.12					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LIGHT

HEADING ANGLE = 0.00 DEGREES

WAVE PERIOD = 11.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.04	.13					

P1 = 2.24086 R1 = 4.53832 AM1 = 1.71285

0.00	-.42	0.00	7.04	.84	0.00	0.00
30.00	-.58	0.00	7.03	.84	0.00	0.00
60.00	-.58	0.00	4.25	.84	0.00	0.00
90.00	-.42	0.00	.32	.84	0.00	0.00
120.00	-.15	0.00	-3.69	.84	0.00	0.00
150.00	.15	0.00	-6.71	.84	0.00	0.00
.17	.26					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LIGHT

HEADING ANGLE = 0.00 DEGREES

WAVE PERIOD = 12.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.17	.26					
P1 = 2.67111	R1 = 3.22833		AH1 = 1.56731			
0.00	-.84	0.00	15.67	1.69	0.00	0.00
30.00	-1.16	0.00	11.14	1.69	0.00	0.00
60.00	-1.16	0.00	3.62	1.69	0.00	0.00
90.00	-.84	0.00	-4.86	1.69	0.00	0.00
120.00	-.31	0.00	-12.05	1.69	0.00	0.00
150.00	.31	0.00	-16.01	1.69	0.00	0.00
.30	.38					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LIGHT

HEADING ANGLE = 0.00 DEGREES

WAVE PERIOD = 13.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.30	.38					
P1 = 2.69747	R1 = 2.50258		AH1 = 1.46164			
0.00	-1.24	0.00	-12.48	2.13	0.00	0.00
30.00	-1.69	0.00	-4.47	2.13	0.00	0.00
60.00	-1.69	0.00	4.73	2.13	0.00	0.00
90.00	-1.24	0.00	12.68	2.13	0.00	0.00
120.00	-.45	0.00	17.22	2.13	0.00	0.00
150.00	.45	0.00	17.15	2.13	0.00	0.00
.05	.13					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LIGHT

HEADING ANGLE = 10.00 DEGREES

WAVE PERIOD = 11.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.05	.13					
P1 = 2.24086	R1 = 4.53832	AH1 = 1.71285				
0.00	-.42	-.07	3.47	.83	2.28	0.00
30.00	-.57	-.09	3.84	.83	2.28	0.00
60.00	-.56	-.09	3.18	.83	2.28	0.00
90.00	-.41	-.06	1.66	.83	2.28	0.00
120.00	-.14	-.01	-.29	.83	2.28	0.00
150.00	.15	.02	-2.18	.83	2.28	0.00
.17	.27					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LIGHT

HEADING ANGLE = 10.00 DEGREES

WAVE PERIOD = 12.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.17	.27					

P1 = 2.67111 R1 = 3.22833 AH1 = 1.56731

0.00	-.87	-.16	9.71	1.73	1.36	0.00
30.00	-1.18	-.19	7.51	1.73	1.36	0.00
60.00	-1.18	-.17	3.30	1.73	1.36	0.00
90.00	-.86	-.10	-1.79	1.73	1.36	0.00
120.00	-.31	0.00	-6.41	1.73	1.36	0.00
150.00	.32	.09	-9.30	1.73	1.36	0.00
.31	.38					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LIGHT

HEADING ANGLE = 10.00 DEGREES

WAVE PERIOD = 13.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.31	.38					
P1 = 2.69747	R1 = 2.50258		AH1 = 1.46164			
0.00	-1.22	-.24	-6.68	2.09	.90	0.00
30.00	-1.67	-.27	-1.55	2.09	.90	0.00
60.00	-1.66	-.23	3.99	2.09	.90	0.00
90.00	-1.21	-.13	8.46	2.09	.90	0.00
120.00	-.44	0.00	10.67	2.09	.90	0.00
150.00	.45	.13	10.01	2.09	.90	0.00
.06	.17					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LIGHT

HEADING ANGLE = 20.00 DEGREES

WAVE PERIOD = 11.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.06	.17					
P1 = 2.24086	R1 = 4.53832		AH1 = 1.71285			
0.00	-.52	-.20	1.37	1.03	4.50	-.01
30.00	-.71	-.24	2.71	1.03	4.50	-.01
60.00	-.70	-.21	3.31	1.03	4.50	-.01
90.00	-.51	-.12	3.03	1.03	4.50	-.01
120.00	-.18	0.00	1.93	1.03	4.50	-.01
150.00	.20	.11	.32	1.03	4.50	-.01
.22	.30					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LIGHT

HEADING ANGLE = 20.00 DEGREES

WAVE PERIOD = 12.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.22	.30					
P1 = 2.67111	R1 = 3.22833	AH1 = 1.56731				
0.00	-.92	-.38	7.02	1.83	2.69	-.01
30.00	-1.25	-.43	6.22	1.83	2.69	-.01
60.00	-1.25	-.36	3.76	1.83	2.69	-.01
90.00	-.91	-.20	.28	1.83	2.69	-.01
120.00	-.32	.01	-3.26	1.83	2.69	-.01
150.00	.34	.23	-5.93	1.83	2.69	-.01
.36	.43					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 531.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LIGHT

HEADING ANGLE = 20.00 DEGREES

WAVE PERIOD = 13.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.36	.43					
P1 = 2.69747	R1 = 2.50258		AH1 = 1.46164			
0.00	-1.32	-.55	-4.06	2.26	1.77	-.01
30.00	-1.80	-.62	.08	2.26	1.77	-.01
60.00	-1.79	-.51	4.21	2.26	1.77	-.01
90.00	-1.30	-.27	7.20	2.26	1.77	-.01
120.00	-.47	.03	8.27	2.26	1.77	-.01
150.00	.49	.34	7.12	2.26	1.77	-.01
.13	.23					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LIGHT

HEADING ANGLE = 30.00 DEGREES

WAVE PERIOD = 11.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.13	.23					
P1 = 2.24085	R1 = 4.53832	AH1 = 1.71285				
0.00	-.65	-.44	-.79	1.29	6.58	-.01
30.00	-.88	-.48	1.52	1.29	6.58	-.01
60.00	-.88	-.40	3.44	1.29	6.58	-.01
90.00	-.63	-.20	4.43	1.29	6.58	-.01
120.00	-.22	.03	4.23	1.29	6.58	-.01
150.00	.25	.27	2.90	1.29	6.58	-.01
.29	.37					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LIGHT

HEADING ANGLE = 30.00 DEGREES

WAVE PERIOD = 12.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.28	.37					
P1 = 2.67111	R1 = 3.22833	AH1 = 1.56731				
0.00	-1.05	-.71	4.33	2.08	3.93	-.01
30.00	-1.43	-.78	4.93	2.08	3.93	-.01
60.00	-1.42	-.63	4.21	2.08	3.93	-.01
90.00	-1.03	-.32	2.35	2.08	3.93	-.01
120.00	-.36	.08	-.12	2.08	3.93	-.01
150.00	.39	.46	-2.57	2.08	3.93	-.01
.42	.48					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LIGHT

HEADING ANGLE = 30.00 DEGREES

WAVE PERIOD = 13.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.42	.48					
P1 = 2.69747	R1 = 2.50258	AH1 = 1.46164				
0.00	-1.36	-.93	-.75	2.33	2.60	-.02
30.00	-1.85	-1.01	2.04	2.33	2.60	-.02
60.00	-1.84	-.02	4.30	2.33	2.60	-.02
90.00	-1.34	-.41	5.40	2.33	2.60	-.02
120.00	-.47	.11	5.05	2.33	2.60	-.02
150.00	.51	.60	3.35	2.33	2.60	-.02

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 851.00 FT.

BEAM = 102.00 FT.

DRAFT CONDITION = LOADED

HEADING ANGLE = 0.00 DEGREES

WAVE PERIOD = 10.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
0.00	.02					
P1 = 1.85679	R1 = 1.96571	AM1 = 2.26526				
0.00	-.06	0.00	.09	.11	0.00	0.00
30.00	-.09	0.00	1.03	.11	0.00	0.00
60.00	-.09	0.00	.77	.11	0.00	0.00
90.00	-.06	0.00	.32	.11	0.00	0.00
120.00	-.02	0.00	-.21	.11	0.00	0.00
150.00	.02	0.00	-.70	.11	0.00	0.00
.24	.13					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.20 FT.

BEAM = 102.00 FT.

DRAFT CONDITION = LOADED

HEADING ANGLE = 0.00 DEGREES

WAVE PERIOD = 11.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.04	.13					
P1 = 2.24056	R1 = 3.36660	AH1 = 2.23004				
0.00	-.42	0.00	7.94	.84	0.00	0.00
30.00	-.55	0.00	7.14	.84	0.00	0.00
60.00	-.38	0.00	4.43	.84	0.00	0.00
90.00	-.42	0.00	.52	.84	0.00	0.00
120.00	-.15	0.00	-3.61	.84	0.00	0.00
150.00	.15	0.00	-6.61	.84	0.00	0.00
.17	.28					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION = LOADED

HEADING ANGLE = 0.00 DEGREES

WAVE PERIOD = 12.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.17	.26					
P1 = 2.67111	R1 = 5.04117	AH1 = 2.04837				
0.00	-.65	0.00	15.00	1.69	0.00	0.00
30.00	-1.17	0.00	11.53	1.69	0.00	0.00
60.00	-1.17	0.00	4.26	1.69	0.00	0.00
90.00	-.35	0.00	-4.00	1.69	0.00	0.00
120.00	-.71	0.00	-11.65	1.69	0.00	0.00
150.10	.71	0.00	-15.91	1.69	0.00	0.00
.30	.38					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 331.00 FT.

BEAM = 102.00 FT.

DRAFT CONDITION = LOADED

HEADING ANGLE = 0.00 DEGREES

WAVE PERIOD = 13.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.70	.32					
S1 = 2.59747	R1 = 4.73846	AR1 = 1.36471				
0.00	-1.25	0.00	-12.03	2.13	0.00	0.00
30.00	-1.71	0.00	-3.74	2.13	0.00	0.00
60.00	-1.71	0.00	5.54	2.13	0.00	0.00
90.00	-1.25	0.00	13.35	2.13	0.00	0.00
120.00	-.45	0.00	17.58	2.13	0.00	0.00
150.00	.45	0.00	17.10	2.13	0.00	0.00
0.00	0.00					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.00 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 10.00 DEGREES

WAVE PERIOD = 6.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
0.00	0.00					

P1 = .40513 R1 = .34857 AH1 = .59526

0.00	0.00	.01	.25	0.00	.59	0.00
30.00	0.00	0.00	.45	0.00	.59	0.00
60.00	0.00	0.00	.52	0.00	.59	0.00
90.00	0.00	-.01	.45	0.00	.59	0.00
120.00	0.00	-.02	.26	0.00	.59	0.00
150.00	0.00	-.01	0.00	0.00	.59	0.00
0.00	0.00					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 10.00 DEGREES

WAVE PERIOD = 7.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
0.00	0.00					

PI = .57762 PI = .52437 AMI = 1.02739

0.00	0.00	.01	.28	0.00	.55	0.00
30.00	0.00	0.00	.49	0.00	.65	0.00
60.00	0.00	-.01	.56	0.00	.65	0.00
90.00	0.00	-.02	.50	0.00	.65	0.00
120.00	0.00	-.02	.29	0.00	.65	0.00
150.00	0.00	-.02	.11	0.00	.65	0.00
0.00	0.00					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 10.00 DEGREES

WAVE PERIOD = 8.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
0.00	0.00					

P1 = .82151 P1 = .78995 AH1 = 1.48239

0.00	0.00	.01	.33	0.00	.75	0.00
30.00	0.00	0.00	.33	0.00	.75	0.00
60.00	0.00	-.01	.67	0.00	.75	0.00
90.00	0.00	-.02	.67	0.00	.75	0.00
120.00	0.00	-.02	.33	0.00	.75	0.00
150.00	0.00	-.02	0.00	0.00	.75	0.00
0.00	0.00					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.00 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 10.00 DEGREES

WAVE PERIOD = 9.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
0.00	0.00					

P1 = 1.17029 R1 = 1.21665 AH1 = 1.97936

0.00	0.00	.01	.44	0.00	.91	0.00
30.00	0.00	0.00	.72	0.00	.91	0.00
60.00	0.00	-.01	.91	0.00	.91	0.00
90.00	0.00	-.02	.98	0.00	.91	0.00
120.00	0.00	-.03	.86	0.00	.91	0.00
150.00	0.00	-.02	-.04	0.00	.91	0.00
0.00	.02					

DEAD WEIGHT TONNAGE = 22500.

LENGTH = 579.20 FT.

BEAM = 77.00 FT.

DRAFT CONDITION - LIGHT

HEADING ANGLE = 10.00 DEGREES

WAVE PERIOD = 9.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.03	.12					
P1 = 2.17120	R1 = 3.88220	AH1 = 1.71285				
0.00	-.39	-.05	3.37	1.11	2.92	-.01
30.00	-.52	-.08	3.93	1.11	2.92	-.01
60.00	-.52	-.08	3.42	1.11	2.92	-.01
90.00	-.38	-.06	2.00	1.11	2.92	-.01
120.00	-.13	-.02	.05	1.11	2.92	-.01
150.00	.14	.01	-1.92	1.11	2.92	-.01
.17	.27					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.00 FT.

BEAM = 102.00 FT.

DRAFT CONDITION = LOADED

HEADING ANGLE = 10.00 DEGREES

WAVE PERIOD = 10.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
0.00	.02					
P1 = 1.65679	R1 = 1.96571	AH1 = 2.26526				
0.00	-.06	0.00	1.29	.11	1.19	0.00
30.00	-.09	0.00	1.62	.11	1.19	0.00
60.00	-.08	-.02	1.51	.11	1.19	0.00
90.00	-.06	-.03	.09	.11	1.19	0.00
120.00	-.01	-.03	.21	.11	1.19	0.00
150.00	.02	-.02	-.62	.11	1.19	0.00
.05	.13					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 10.00 DEGREES

WAVE PERIOD = 11.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.05	.13					
P1 = 2.24086	R1 = 3.36660	AH1 = 2.23004				
0.00	-.42	-.05	6.24	.83	1.69	0.00
30.00	-.57	-.07	5.05	.83	1.69	0.00
60.00	-.57	-.07	4.23	.83	1.69	0.00
90.00	-.41	-.06	1.29	.83	1.69	0.00
120.00	-.14	-.02	-2.00	.83	1.69	0.00
150.00	.15	.01	-4.76	.83	1.69	0.00
.17	.27					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.00 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 10.00 DEGREES

WAVE PERIOD = 12.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.17	.27					
P1 = 2.67111	R1 = 5.04117	AN1 = 2.04937				
0.00	-.88	-.13	12.30	1.73	2.13	0.00
30.00	-1.20	-.16	9.38	1.73	2.13	0.00
60.00	-1.19	-.14	3.[illegible]4	1.73	2.13	0.00
90.00	-.87	-.09	-2.54	1.73	2.13	0.00
120.00	-.31	-.01	-8.[illegible]5	1.73	2.13	0.00
150.00	.32	.06	-11.03	1.73	2.13	0.00
.31	.38					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.00 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 10.00 DEGREES

WAVE PERIOD = 13.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.31	.38					

P1 = 2.69747 R1 = 4.43846 AH1 = 1.86471

0.00	-1.24	-.19	-7.00	2.09	1.60	0.00
30.00	-1.68	-.23	-1.36	2.09	1.60	0.00
60.00	-1.58	-.20	4.64	2.09	1.60	0.00
90.00	-1.22	-.12	9.40	2.09	1.60	0.00
120.00	-.44	-.01	11.65	2.09	1.60	0.00
150.00	.45	.10	10.77	2.09	1.60	0.00
0.00	0.00					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 20.00 DEGREES

WAVE PERIOD = 6.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
0.00	0.00					
P1 = .40513	R1 = .34857	AH1 = .69326				
0.00	0.00	.01	.50	0.00	1.16	0.00
30.00	0.00	0.00	.89	0.00	1.16	0.00
60.00	0.00	-.01	1.03	0.00	1.16	0.00
90.00	0.00	-.02	.90	0.00	1.16	0.00
120.00	0.00	-.02	.52	0.00	1.16	0.00
150.00	0.00	-.02	0.00	0.00	1.16	0.00
0.00	0.00					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 851.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 20.00 DEGREES

WAVE PERIOD = 7.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
0.00	0.00					

P1 = .57762 R1 = .52437 AM1 = 1.02739

0.00	0.00	.01	.55	0.00	1.28	0.00
30.00	0.00	0.00	.98	0.00	1.28	0.00
60.00	0.00	-.01	1.14	0.00	1.28	0.00
90.00	0.00	-.02	1.00	0.00	1.28	0.00
120.00	0.00	-.03	.59	0.00	1.28	0.00
150.00	0.00	-.02	.02	0.00	1.28	0.00
0.00	0.00					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 331.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 20.00 DEGREES

WAVE PERIOD = 8.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
0.00	0.00					
P1 = .82151	R1 = .78935	AH1 = 1.48239				
0.00	0.00	.02	.66	0.00	1.48	-.01
30.00	0.00	0.00	1.14	0.00	1.48	-.01
60.00	0.00	-.01	1.31	0.00	1.48	-.01
90.00	0.00	-.03	1.14	0.00	1.48	-.01
120.00	0.00	-.03	.65	0.00	1.48	-.01
150.00	0.00	-.03	0.00	0.00	1.48	-.01
0.00	0.00					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 20.00 DEGREES

WAVE PERIOD = 9.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
0.00	0.00					

P1 = 1.17029 R1 = 1.21665 AH1 = 1.97936

0.00	0.00	.02	.88	0.00	1.80	-.01
30.00	0.00	0.00	1.43	0.00	1.80	-.01
60.00	0.00	-.01	1.60	0.00	1.80	-.01
90.00	0.00	-.03	1.35	0.00	1.80	-.01
120.00	0.00	-.04	.71	0.00	1.80	-.01
150.00	0.00	-.03	-.09	0.00	1.80	-.01
.01	.05					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 20.00 DEGREES

WAVE PERIOD = 10.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.01	.05					
P1 = 1.65679	R1 = 1.96571	AH1 = 2.26526				
0.00	-.16	-.03	2.38	.27	2.36	-.01
30.00	-.21	-.05	3.05	.27	2.36	-.01
60.00	-.20	-.06	2.91	.27	2.36	-.01
90.00	-.14	-.06	1.98	.27	2.36	-.01
120.00	-.04	-.03	.52	.27	2.36	-.01
150.00	.06	0.00	-1.07	.27	2.36	-.01
.06	.17					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 20.00 DEGREES

WAVE PERIOD = 11.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.06	.17					
P1 = 2.24086	R1 = 3.36660	AH1 = 2.23004				
0.00	-.53	-.16	6.21	1.03	3.34	-.01
30.00	-.72	-.20	6.95	1.03	3.34	-.01
60.00	-.71	-.18	5.22	1.03	3.34	-.01
90.00	-.51	-.11	2.10	1.03	3.34	-.01
120.00	-.18	-.01	-1.58	1.03	3.34	-.01
150.00	.20	.08	-4.85	1.03	3.34	-.01
.22	.30					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 20.00 DEGREES

WAVE PERIOD = 12.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.22	.30					
P1 = 2.67111	R1 = 5.04117	AH1 = 2.04987				
0.00	-.93	-.31	11.97	1.83	4.20	-.01
30.00	-1.27	-.35	9.57	1.83	4.20	-.01
60.00	-1.26	-.31	4.61	1.83	4.20	-.01
90.00	-.91	-.18	-1.59	1.83	4.20	-.01
120.00	-.32	0.00	-7.36	1.83	4.20	-.01
150.00	.35	.17	-11.16	1.83	4.20	-.01
.36	.43					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 20.00 DEGREES

WAVE PERIOD = 13.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.36	.43					

P1 = 2.69747 R1 = 4.43846 AH1 = 1.86471

0.00	-1.34	-.45	-5.08	2.26	3.15	-.01
30.00	-1.82	-.51	-.14	2.26	3.15	-.01
60.00	-1.81	-.43	4.82	2.26	3.15	-.01
90.00	-1.32	-.24	8.50	2.26	3.15	-.01
120.00	-.47	.01	9.90	2.26	3.15	-.01
150.00	.50	.27	8.65	2.26	3.15	-.01
0.00	0.00					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 30.00 DEGREES

WAVE PERIOD = 6.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
0.00	0.00					
P1 = .40513	P1 = .34857	AR1 = .69526				
0.00	0.00	.01	.74	0.00	1.70	-.01
30.00	0.00	0.00	1.30	0.00	1.70	-.01
60.00	0.00	0.00	1.51	0.00	1.70	-.01
90.00	0.00	-.01	1.31	0.00	1.70	-.01
120.00	0.00	-.01	.76	0.00	1.70	-.01
150.00	0.00	-.01	.01	0.00	1.70	-.01
0.00	0.00					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 30.00 DEGREES

WAVE PERIOD = 7.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
0.00	0.00					
P1 = .57762	R1 = .52437	AH1 = 1.02739				
0.00	0.00	.01	.80	0.00	1.87	-.01
30.00	0.00	0.00	1.43	0.00	1.87	-.01
60.00	0.00	-.01	1.67	0.00	1.87	-.01
90.00	0.00	-.01	1.46	0.00	1.87	-.01
120.00	.01	-.02	.86	0.00	1.87	-.01
150.00	.01	-.02	.03	0.00	1.87	-.01
0.00	0.00					

DEAD WEIGHT TONNAGE = 70000.

LENGTH. = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 30.00 DEGREES

WAVE PERIOD = 8.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
0.00	0.00					
P1 = .82151	R1 = .78985	AH1 = 1.48239				
0.00	0.00	.01	.96	0.00	2.16	-.01
30.00	0.00	0.00	1.67	0.00	2.16	-.01
60.00	0.00	-.01	1.92	0.00	2.16	-.01
90.00	.01	-.02	1.66	0.00	2.16	-.01
120.00	.01	-.02	.96	0.00	2.16	-.01
150.00	.01	-.02	0.00	0.00	2.16	-.01
0.00	0.00					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.00 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 30.00 DEGREES

WAVE PERIOD = 9.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
0.00	0.00					

P1 = 1.17029 R1 = 1.21665 AH1 = 1.97936

0.00	0.00	.01	1.29	0.00	2.63	-.01
30.00	0.00	0.00	2.10	0.00	2.63	-.01
60.00	0.00	-.01	2.34	0.00	2.63	-.01
90.00	.01	-.02	1.95	0.00	2.63	-.01
120.00	.01	-.02	1.04	0.00	2.63	-.01
150.00	.01	-.02	-.14	0.00	2.63	-.01
.02	.03					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.00 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 30.00 DEGREES

WAVE PERIOD = 10.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.02	.00					
P1 = 1.65679	R1 = 1.26571	AH1 = 2.26526				
0.00	-.23	-.11	2.83	.40	3.45	-.01
30.00	-.31	-.13	3.82	.40	3.45	-.01
60.00	-.30	-.12	3.78	.40	3.45	-.01
90.00	-.21	-.08	2.73	.40	3.45	-.01
120.00	-.06	-.01	.95	.40	3.45	-.01
150.00	.09	.05	-1.08	.40	3.45	-.01
.13	.23					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 531.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 30.00 DEGREES

WAVE PERIOD = 11.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.13	.23					
P1 = 2.24086	P1 = 3.36650	AH1 = 2.23004				
0.00	-.66	-.36	7.15	1.29	4.88	-.02
30.00	-.89	-.40	7.84	1.29	4.88	-.02
60.00	-.89	-.33	6.42	1.29	4.88	-.02
90.00	-.64	-.18	3.28	1.29	4.88	-.02
120.00	-.22	.02	-.73	1.29	4.88	-.02
150.00	.25	.22	-4.55	1.29	4.88	-.02
.28	.37					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 30.00 DEGREES

WAVE PERIOD = 12.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.28	.37					
P1 = 2.07111	P1 = 5.04117	AH1 = 2.04987				
0.00	-1.06	-.59	11.52	2.08	6.14	-.02
30.00	-1.44	-.65	9.71	2.08	6.14	-.02
60.00	-1.43	-.53	5.30	2.08	6.14	-.02
90.00	-1.04	-.27	-.53	2.08	6.14	-.02
120.00	-.36	.05	-6.22	2.08	6.14	-.02
150.00	.40	.37	-10.24	2.08	6.14	-.02
.42	.48					

DEAD WEIGHT TONNAGE = 70000.

LENGTH = 831.90 FT.

BEAM = 102.00 FT.

DRAFT CONDITION - LOADED

HEADING ANGLE = 30.00 DEGREES

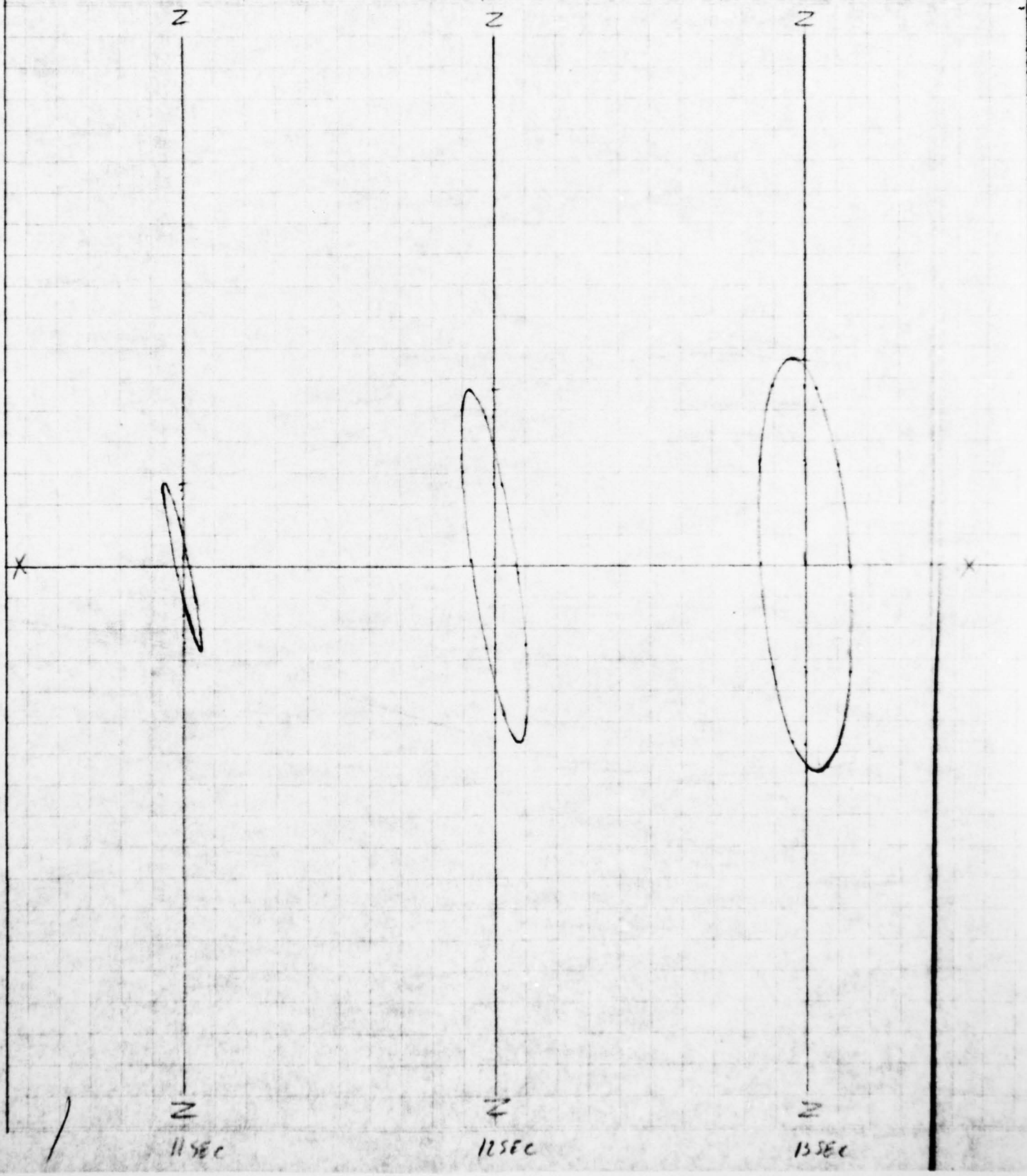
WAVE PERIOD = 13.00 SECONDS

WAVE ANGLE (DEG)	X (FT.)	Y (FT.)	Z (FT.)	PITCH (DEG)	ROLL (DEG)	YAW (DEG)
.42	.48					
P1 = 2.09747	R1 = 4.43846		AH1 = 1.86471			
0.00	-1.38	-.77	-2.40	2.33	4.61	-.02
30.00	-1.87	-.84	1.44	2.33	4.61	-.02
60.00	-1.86	-.69	4.91	2.33	4.61	-.02
90.00	-1.35	-.35	7.06	2.33	4.61	-.02
120.00	-.48	.08	7.31	2.33	4.61	-.02
150.00	.52	.49	5.61	2.33	4.61	-.02

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

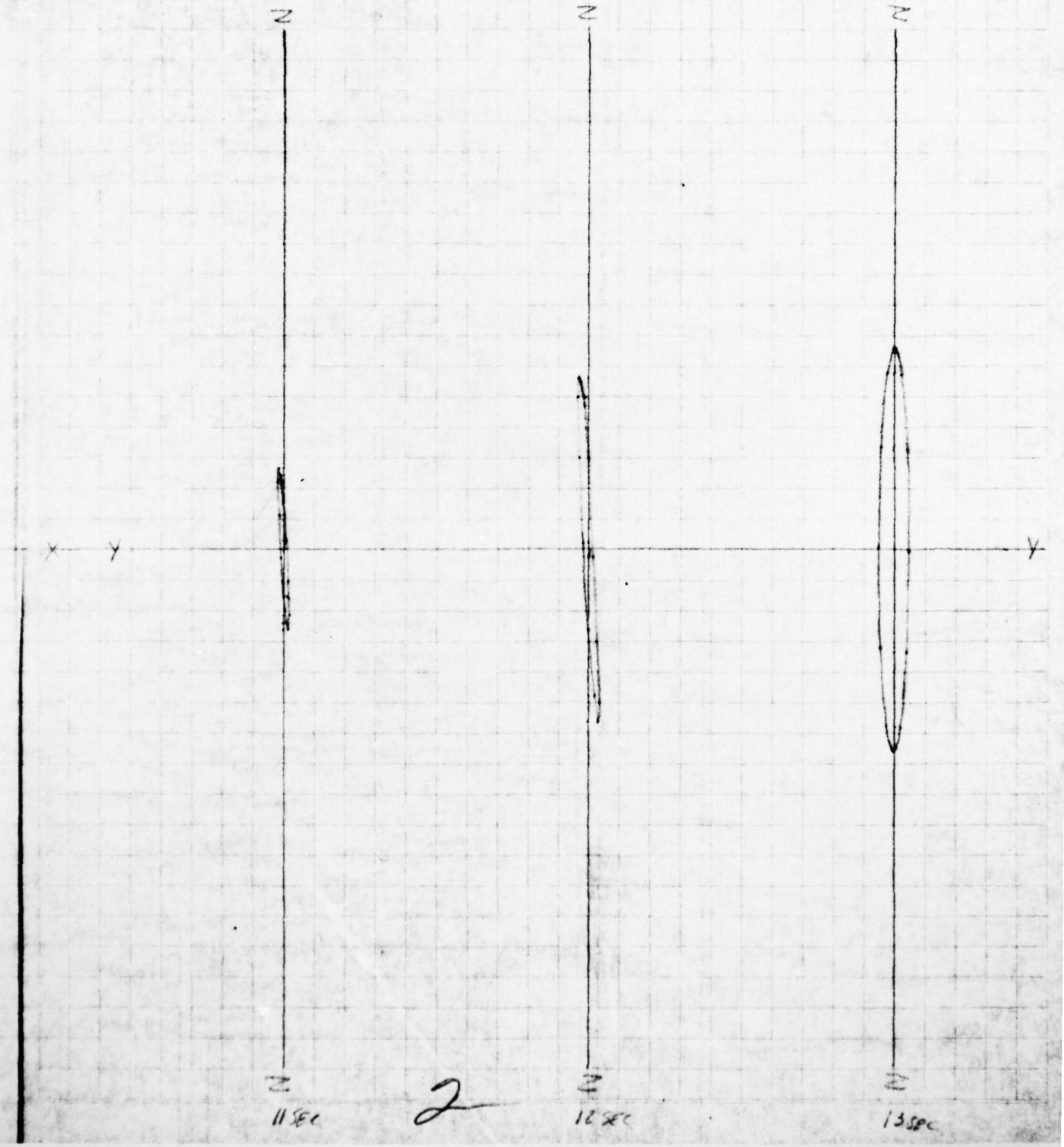
J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE



70000 DWT LIGHT
20° HEADING

ORBITS PLOTTED FOR BUOY LOCATION (1/4L) 1"=5'



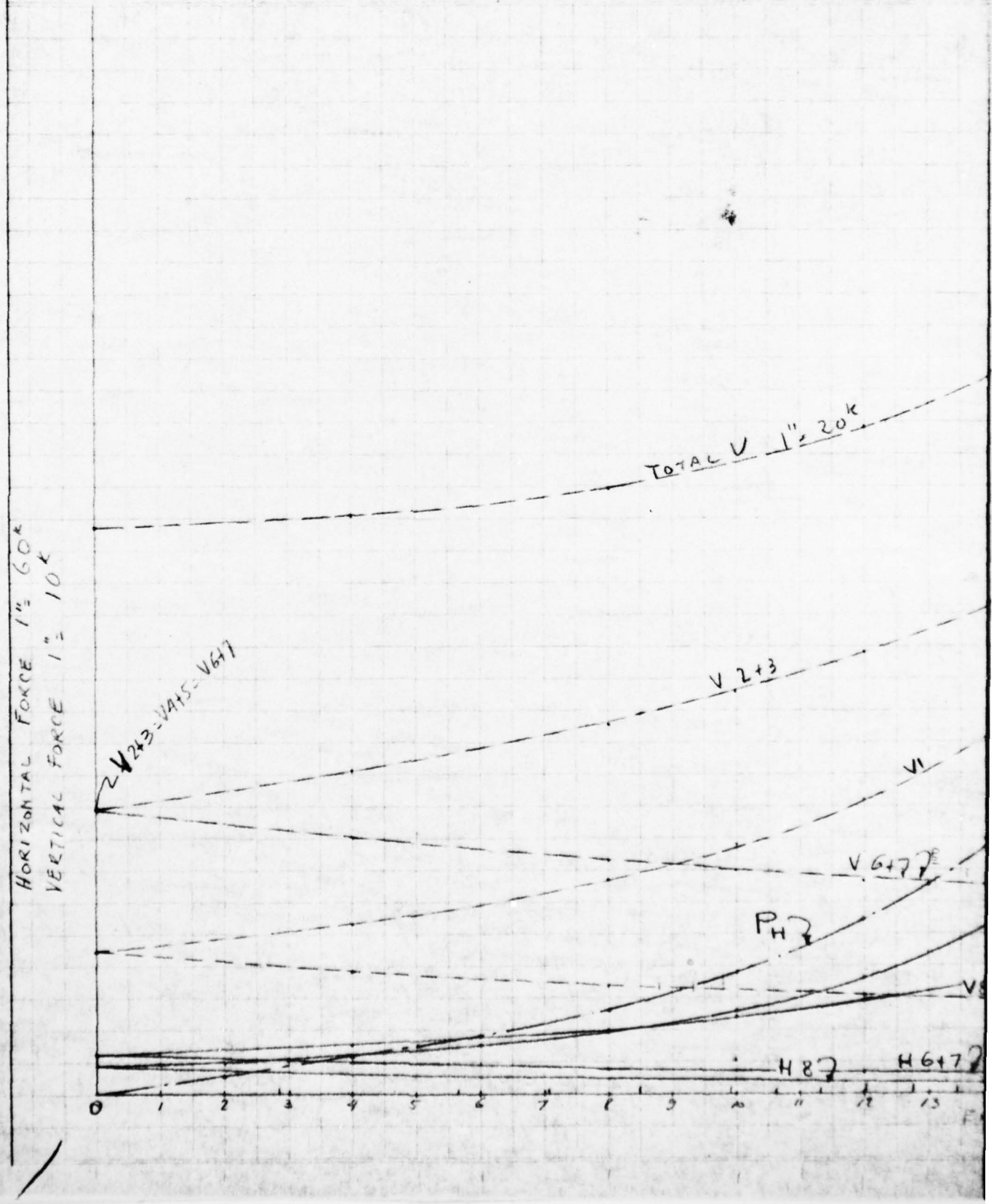
2

ENGINEERING DEPARTMENT
COMPUTATION SHEET

MCD 14003

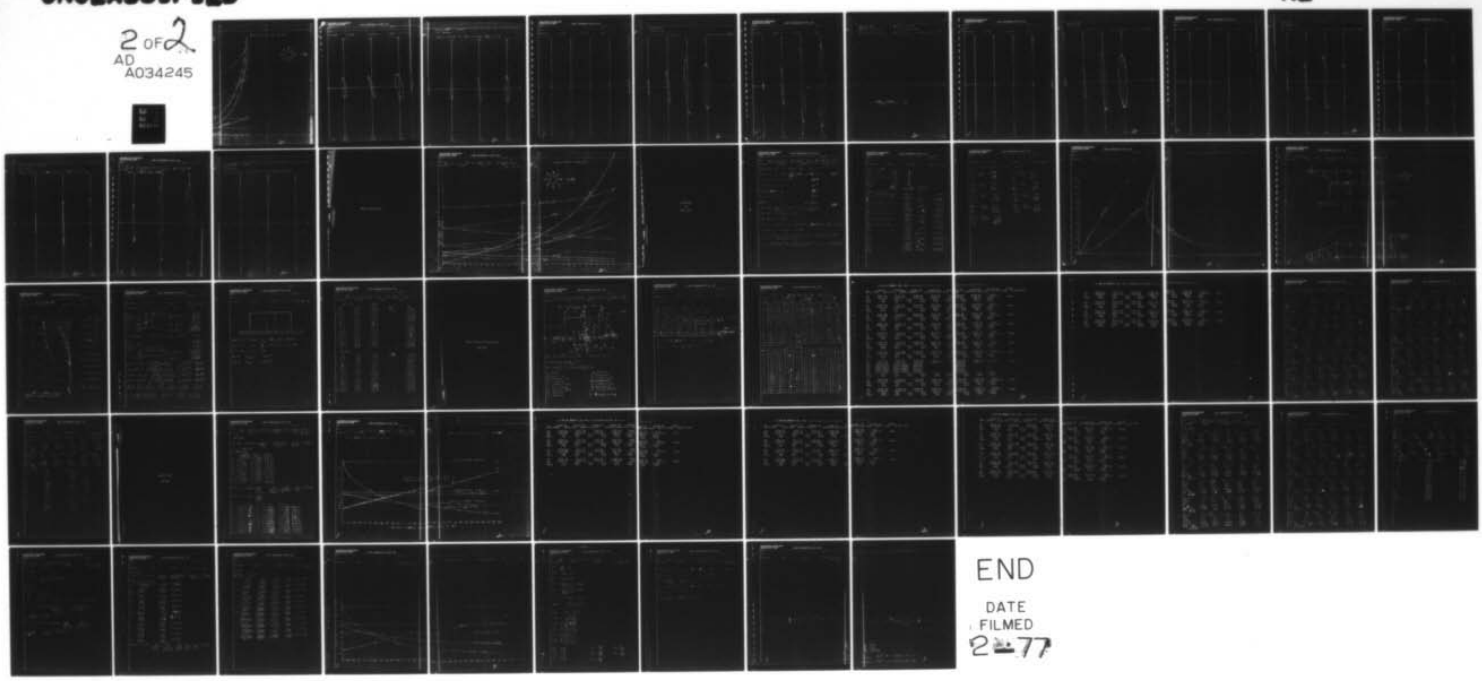
J. RAY MCDERMOTT & CO., INC.

COMPANY			SHEET NO
STATIC			22
SUBJECT: VERT & HORIZ ANCHOR FORCES FOR 60' WATER DEPTH			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE: 12-10-65



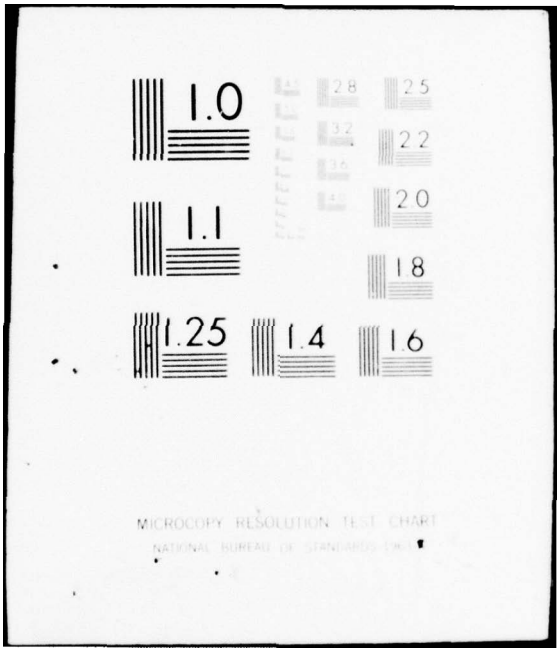
AD-A034 245 MCDERMOTT (J RAY) CO INC NEW ORLEANS LA F/G 13/10
ENGINEERING DESIGN CALCULATIONS MONO-MOORING SYSTEM. VOLUME 4. --ETC(U)
1966 DA-44-009-AMC-841(T)
UNCLASSIFIED NL

2 OF 2
AD
A034245



END

DATE
FILMED
2-77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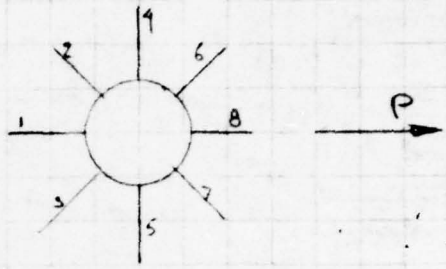
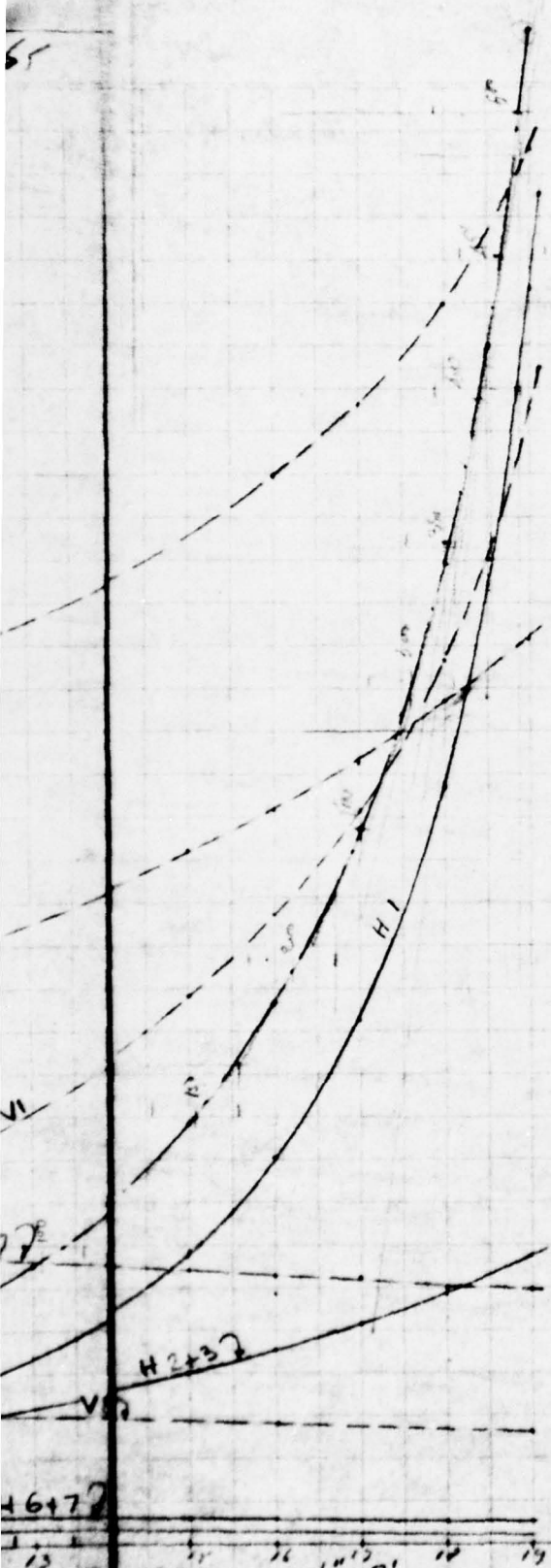
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

ANCHOR FORCES IN 60' W.D.



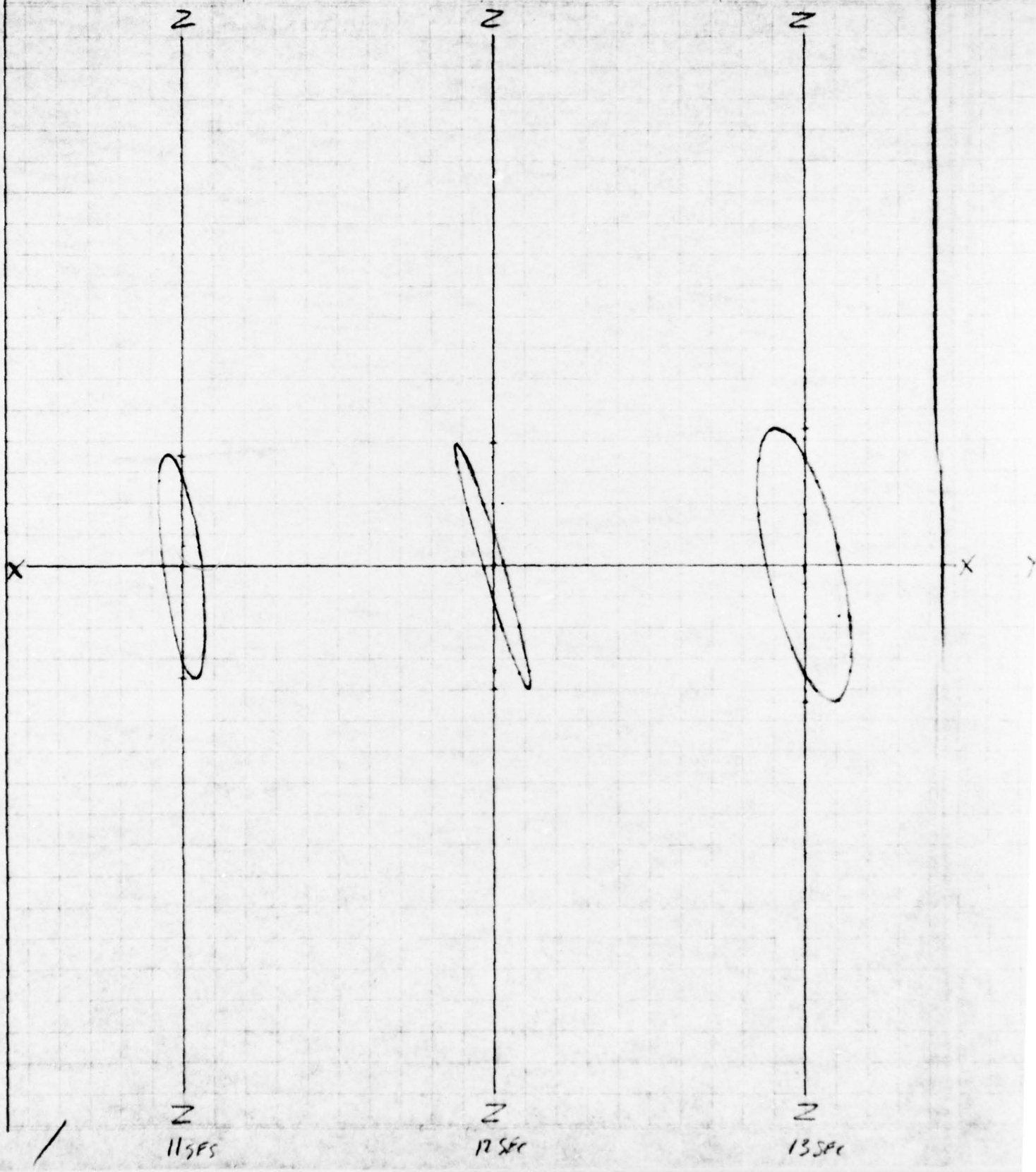


2

ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & Co., INC.

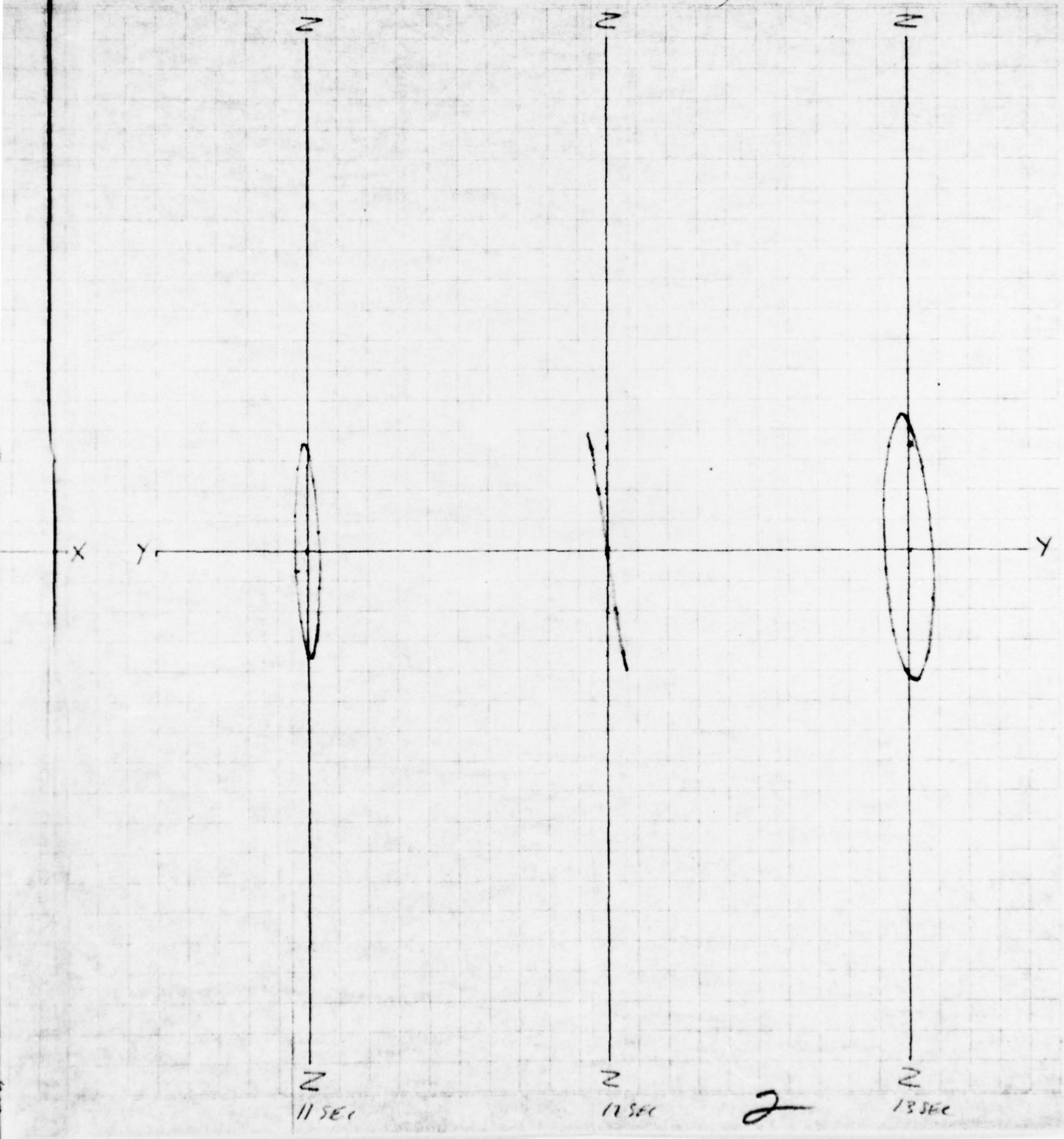
COMPANY			SHEET NO
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE



70,000 DWT LIGHT

30° HEADING

ORBITS PLOTTED FOR BUOY LOCATION (1/8L) 1" = 5'

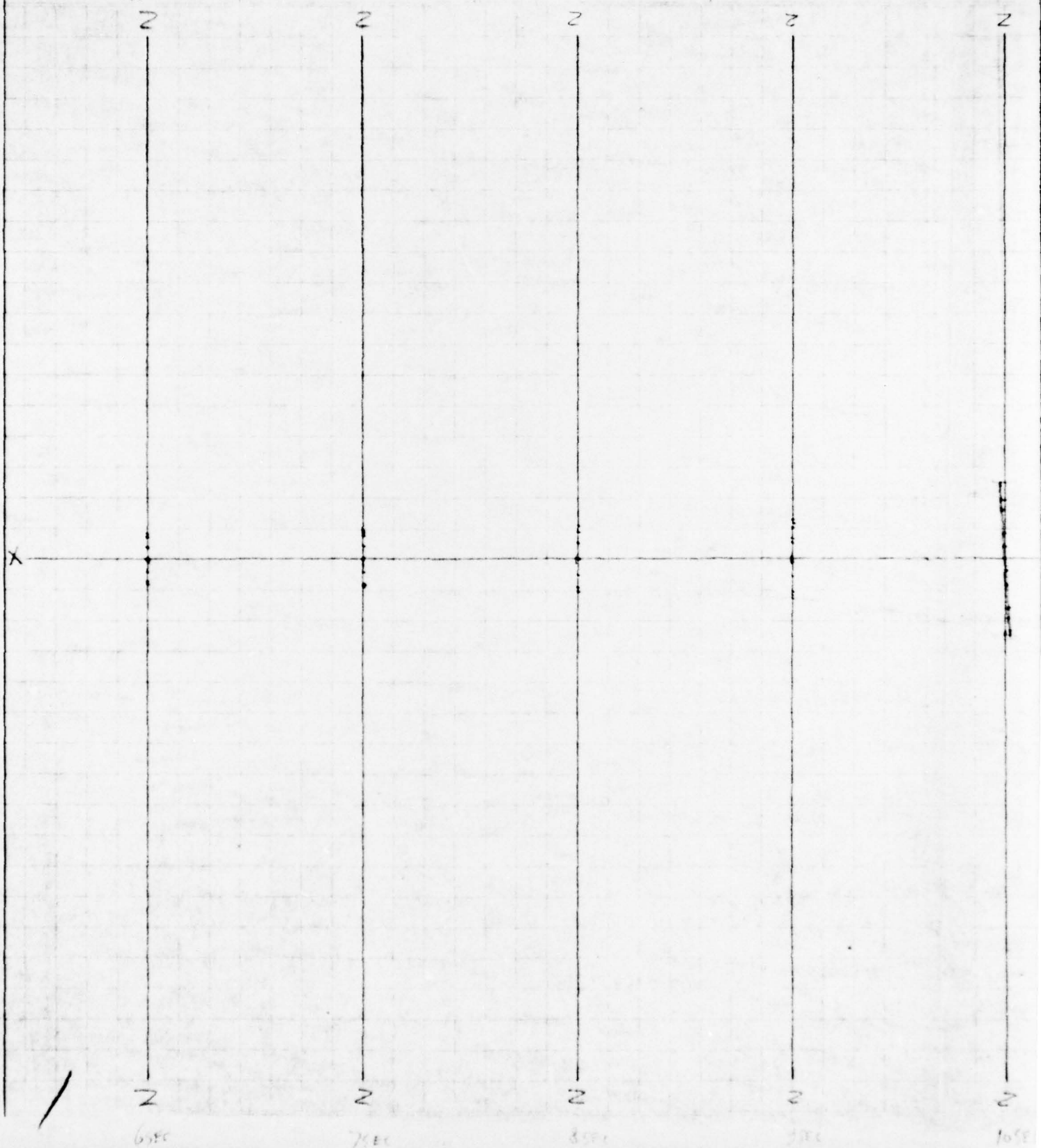


2

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

J. RAY MCDERMOTT & CO., INC.

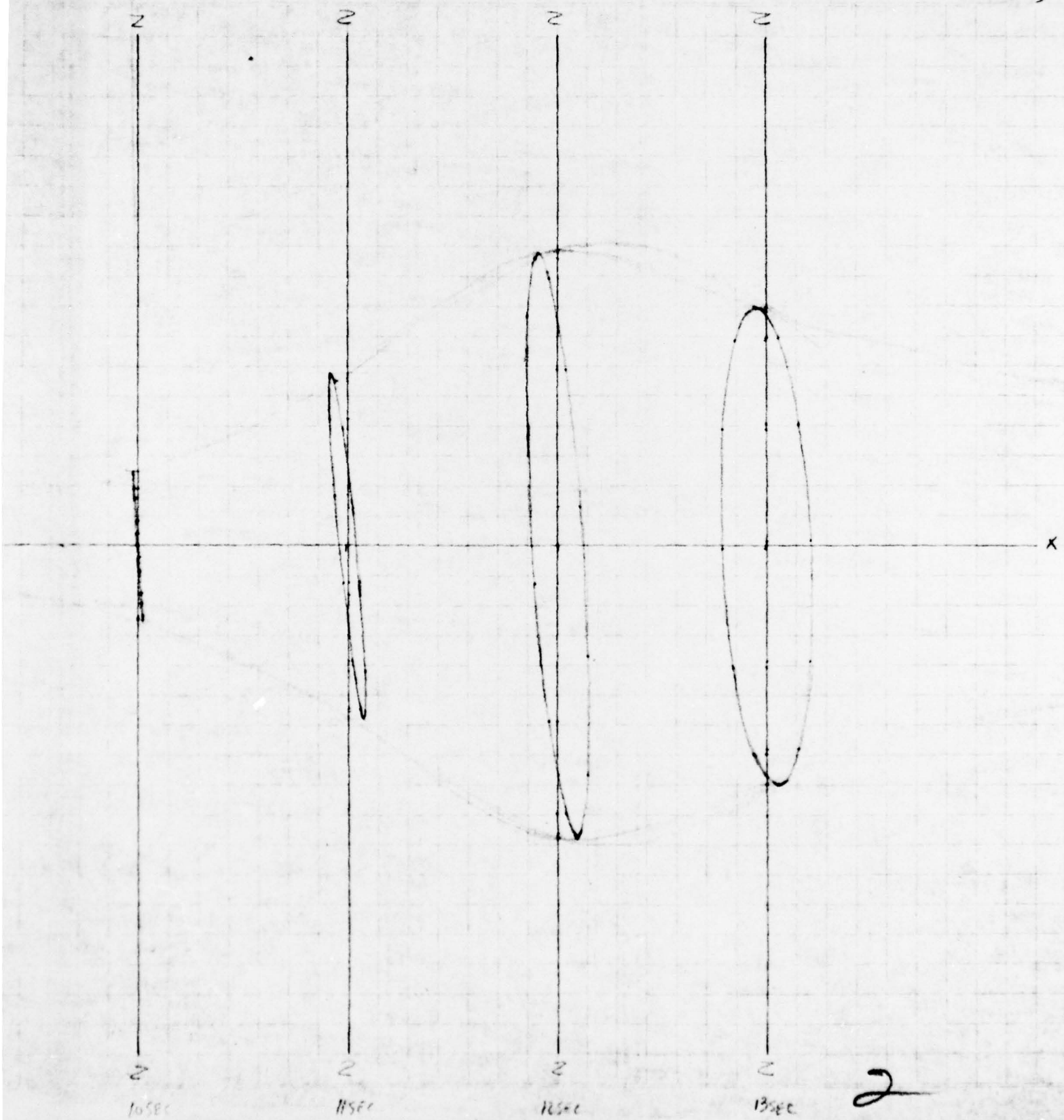
COMPANY			SHEET NO
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE



70,000 DWT
HEAPING 20'

WAVE PERIODS 6, 7, 8, 9, 10, 11, 12, 13

ORBITS PLOTTED FOR BODY LOCATION (¼L)



2

ENGINEERING DEPARTMENT
COMPUTATION SHEET

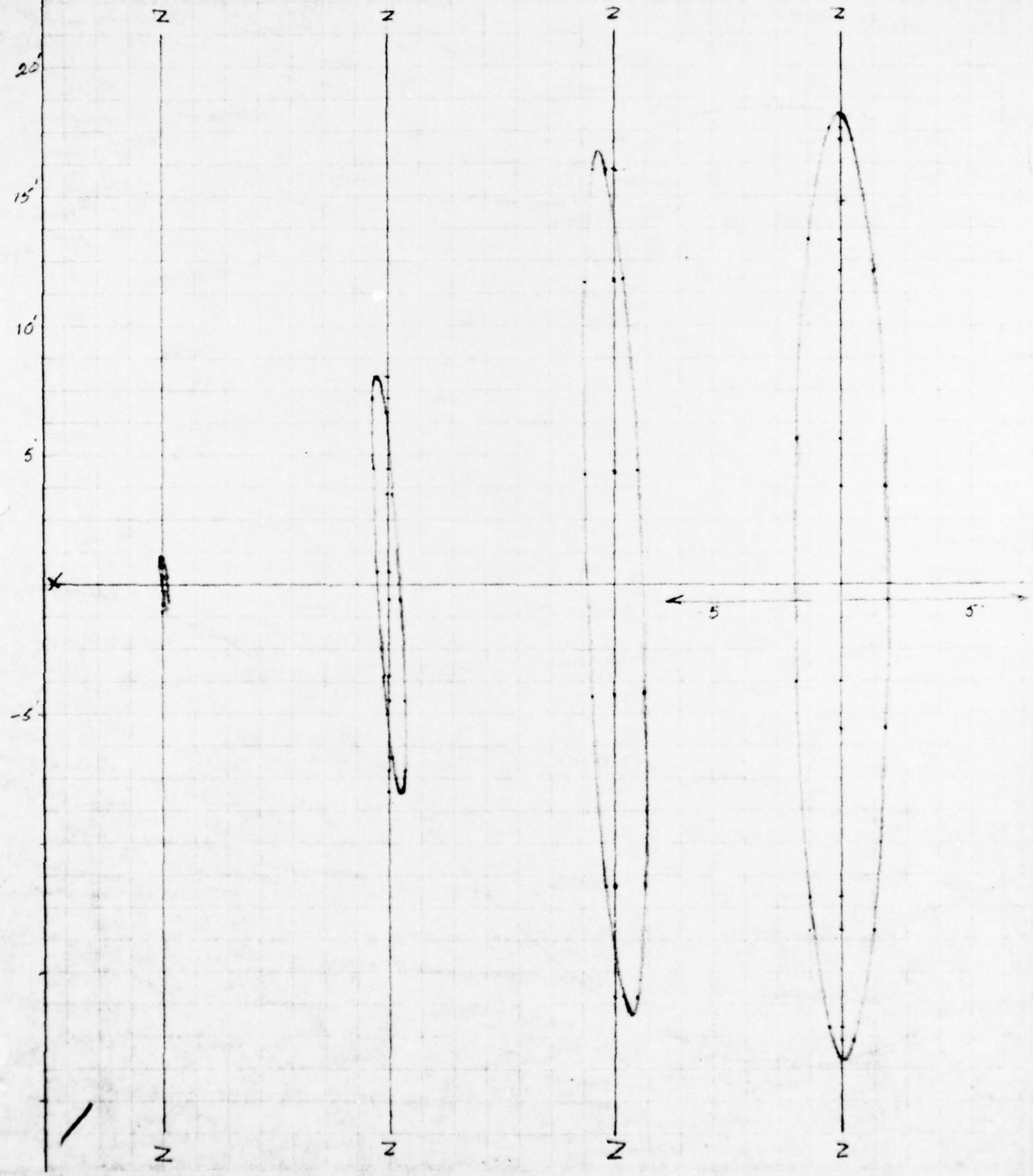
MCD 14003

J. RAY MCDERMOTT & CO., INC.

COMPANY | SHEET NO.

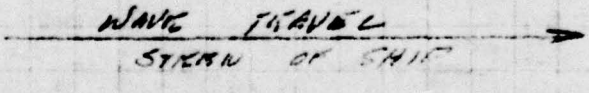
SUBJECT

DRAWING NUMBER | COMPUTER | CHECKED BY | DATE



70,000 DWT
HEADING ANGLE 0°
WAVE PERIOD 10, 11, 12 & 13

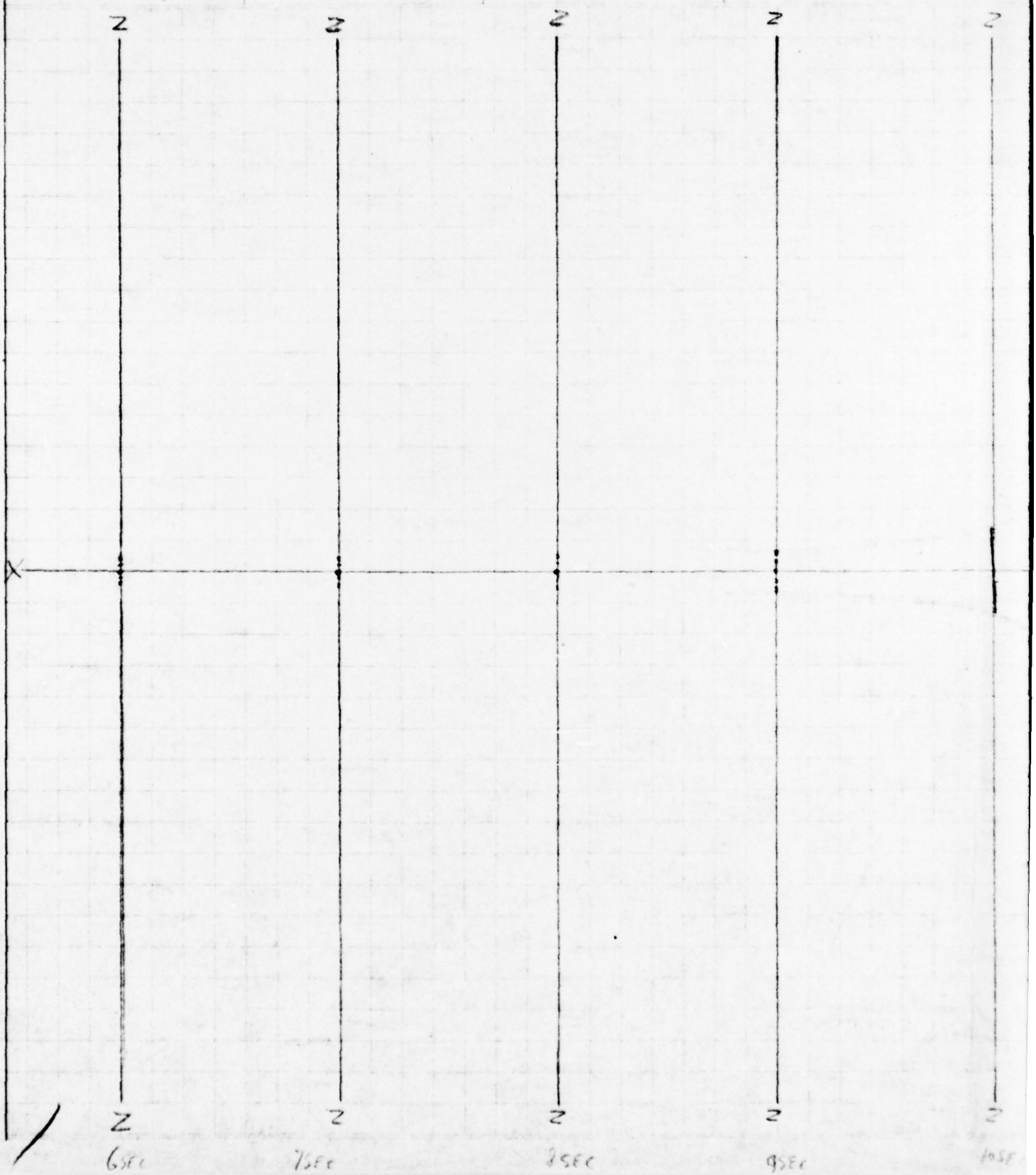
HEAVE, PITCH & SURGE
NO ROLL, SWAY OR YAW
ORBITS PLOTTED AT BUOY LOCATION (100' OFF BOW)



ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

J. RAY MCDERMOTT & CO., INC.

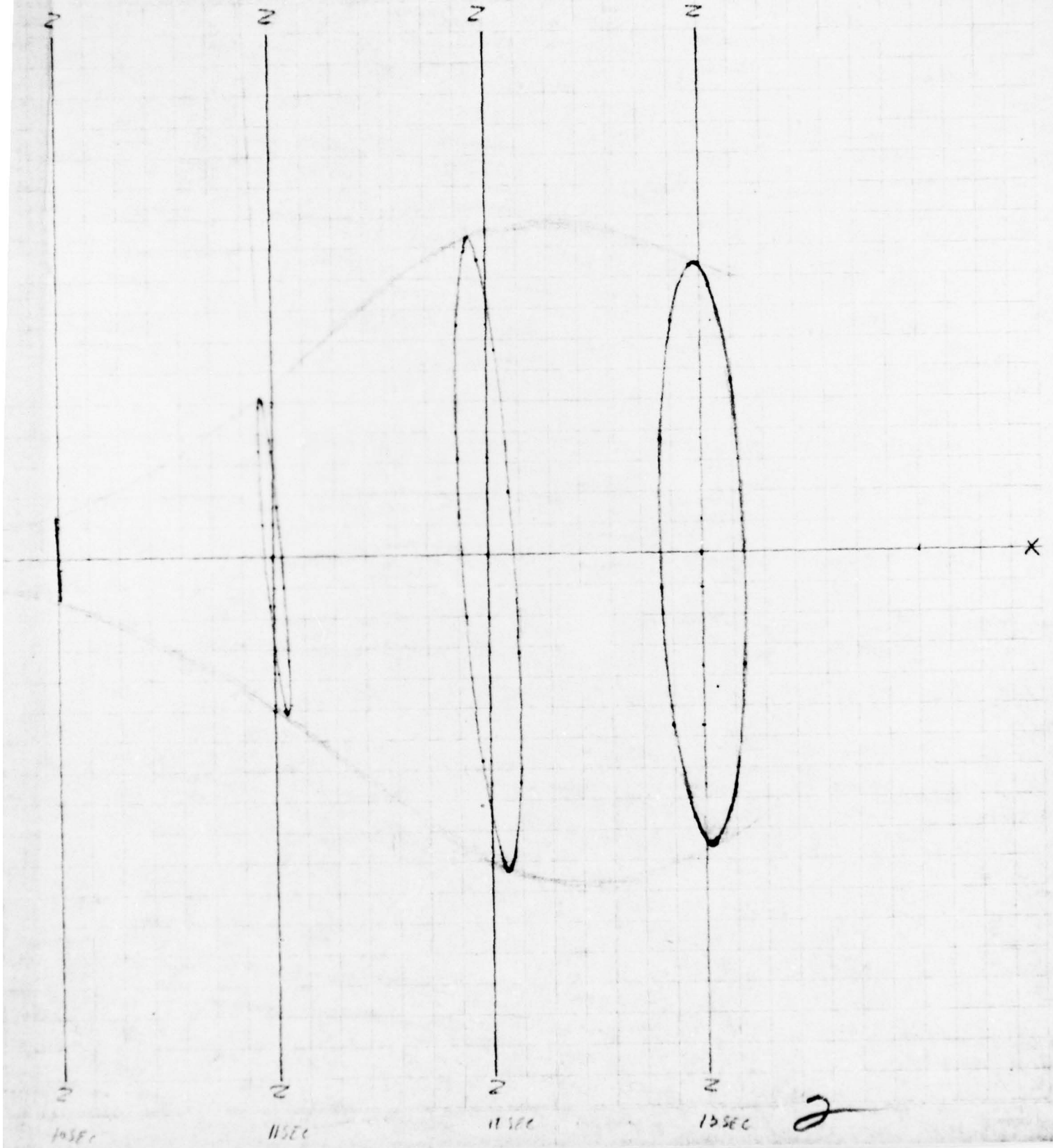
COMPANY			SHEET NO
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE



70,000 PNT
HEADING 10°

WAVE PERIODS 9, 7, 6.5, 6, 5.5, 5, 4.5, 4, 3.5, 3

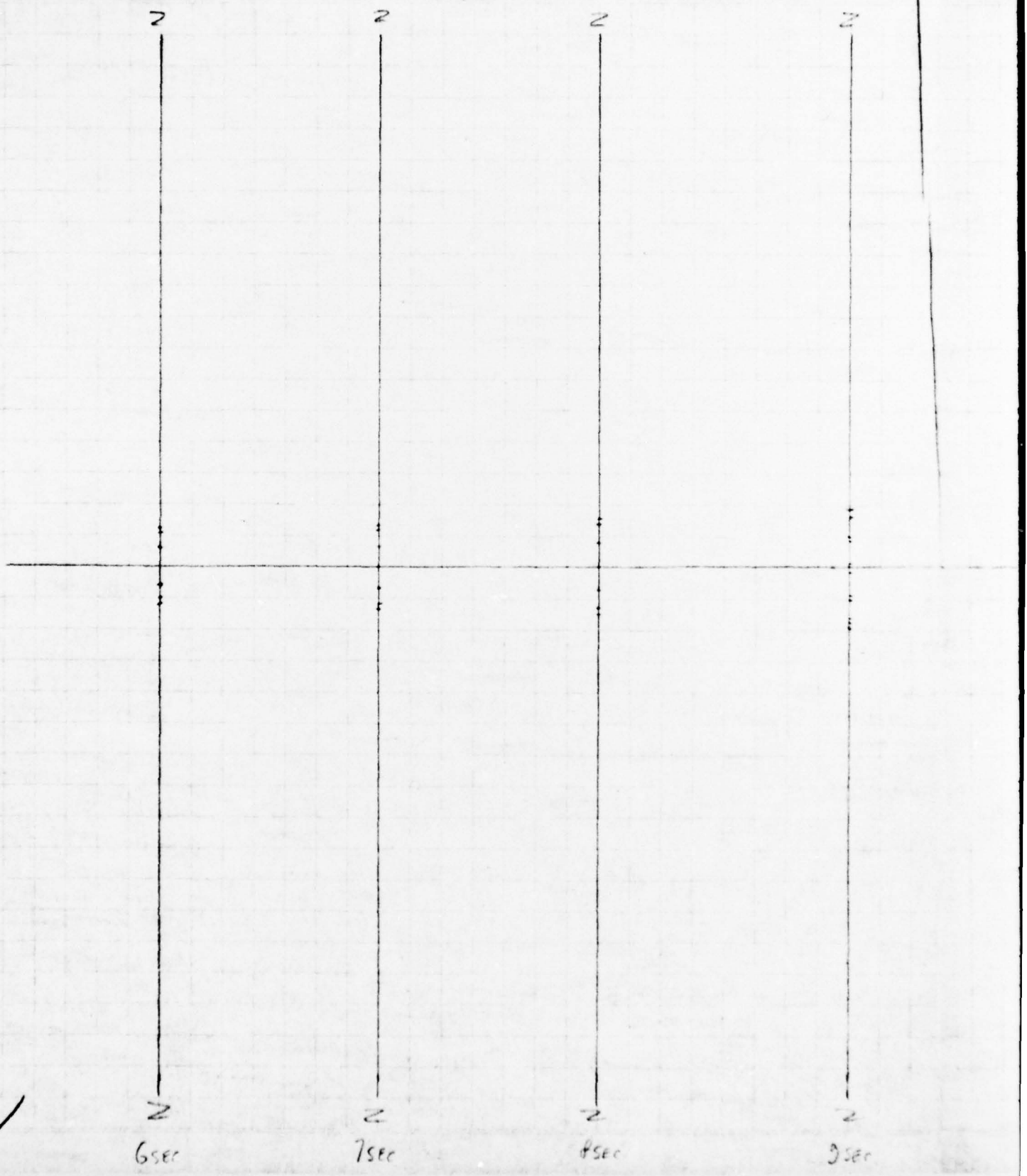
ORBITS PLOTTED FOR BUOY LOCATION (3/4L)



ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

J. RAY MCDERMOTT & CO., INC.

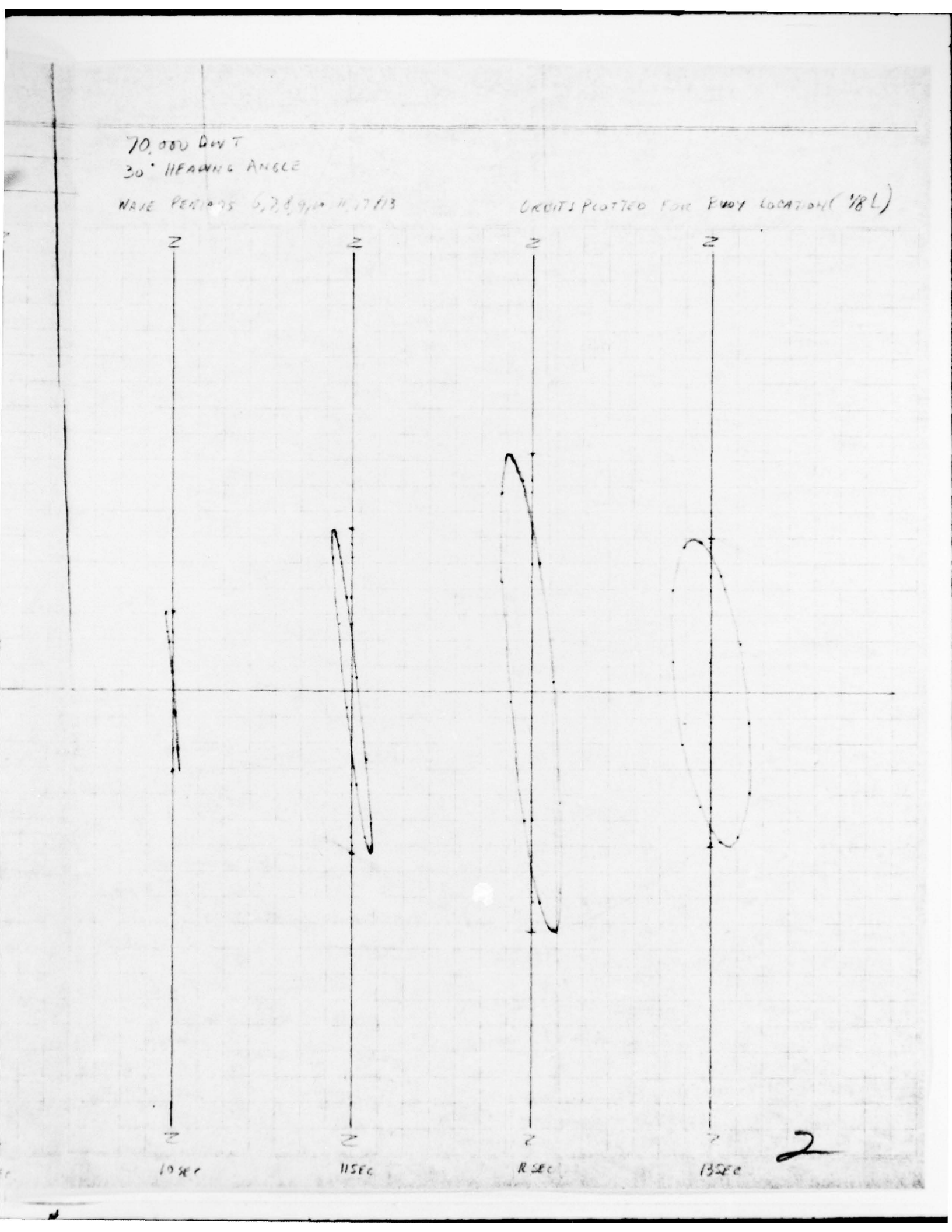
COMPANY			SHEET NO
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE



70,000 DWT
30° HEADING ANGLE

WAVE PERIODS 6, 7, 8, 9, 10, 11, 12, 13

ORBITS PLOTTED FOR BUOY LOCATION (1/8 L)

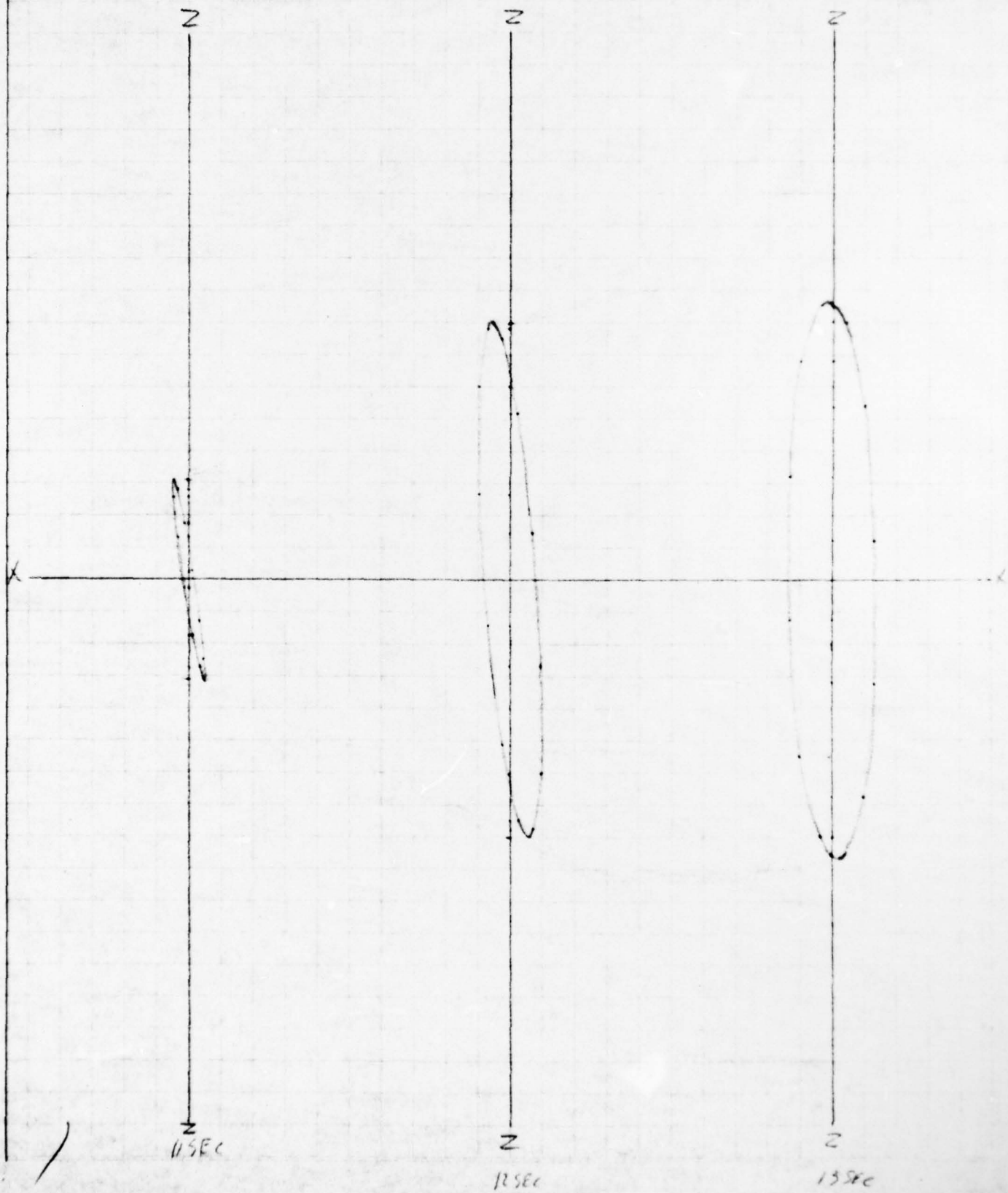


2

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

J. RAY MCDERMOTT & CO., INC.

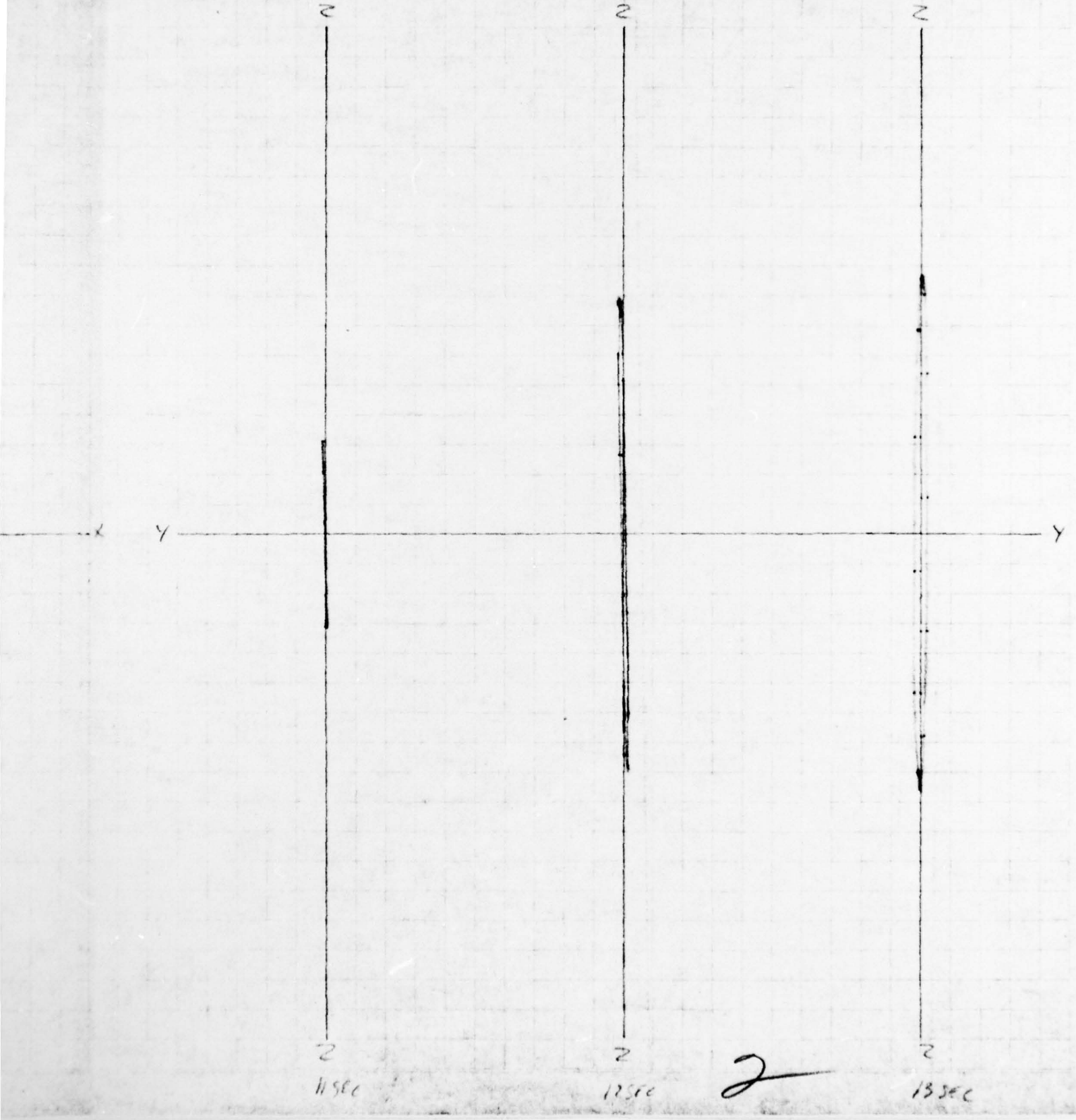
COMPANY			SHEET NO
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE



70,000 DWT LIGHT

10° HEADING

ORBITS PLOTTED FOR BUOY LOCATION (3/8L) 1" = 5'



2

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

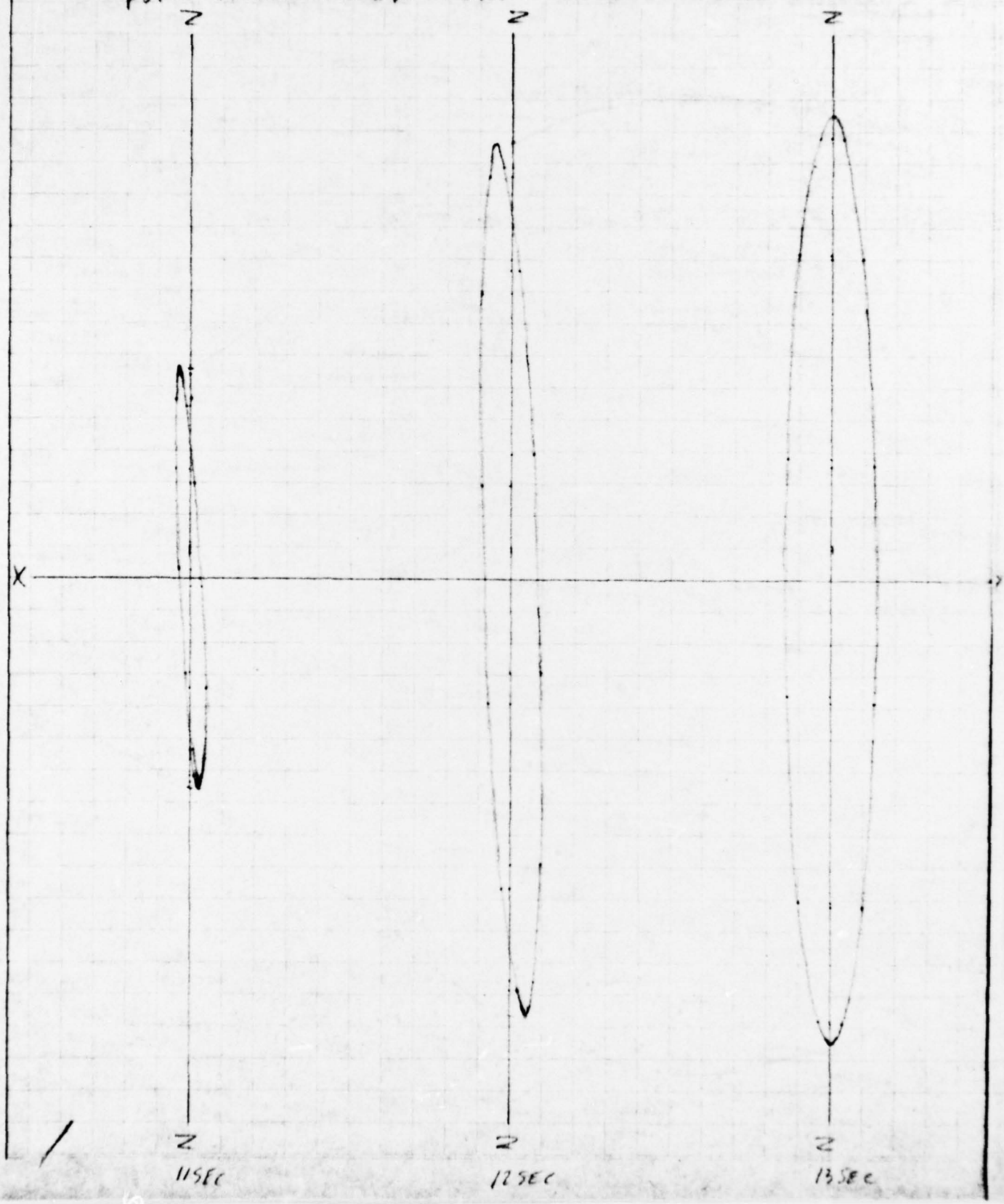
J. RAY MCDERMOTT & CO., INC.

COMPANY | SHEET NO

SUBJECT PLOTS OF ORBITAL MOTION VERSUS WAVE PERIOD

DRAWING NUMBER | COMPUTER | CHECKED BY | DATE

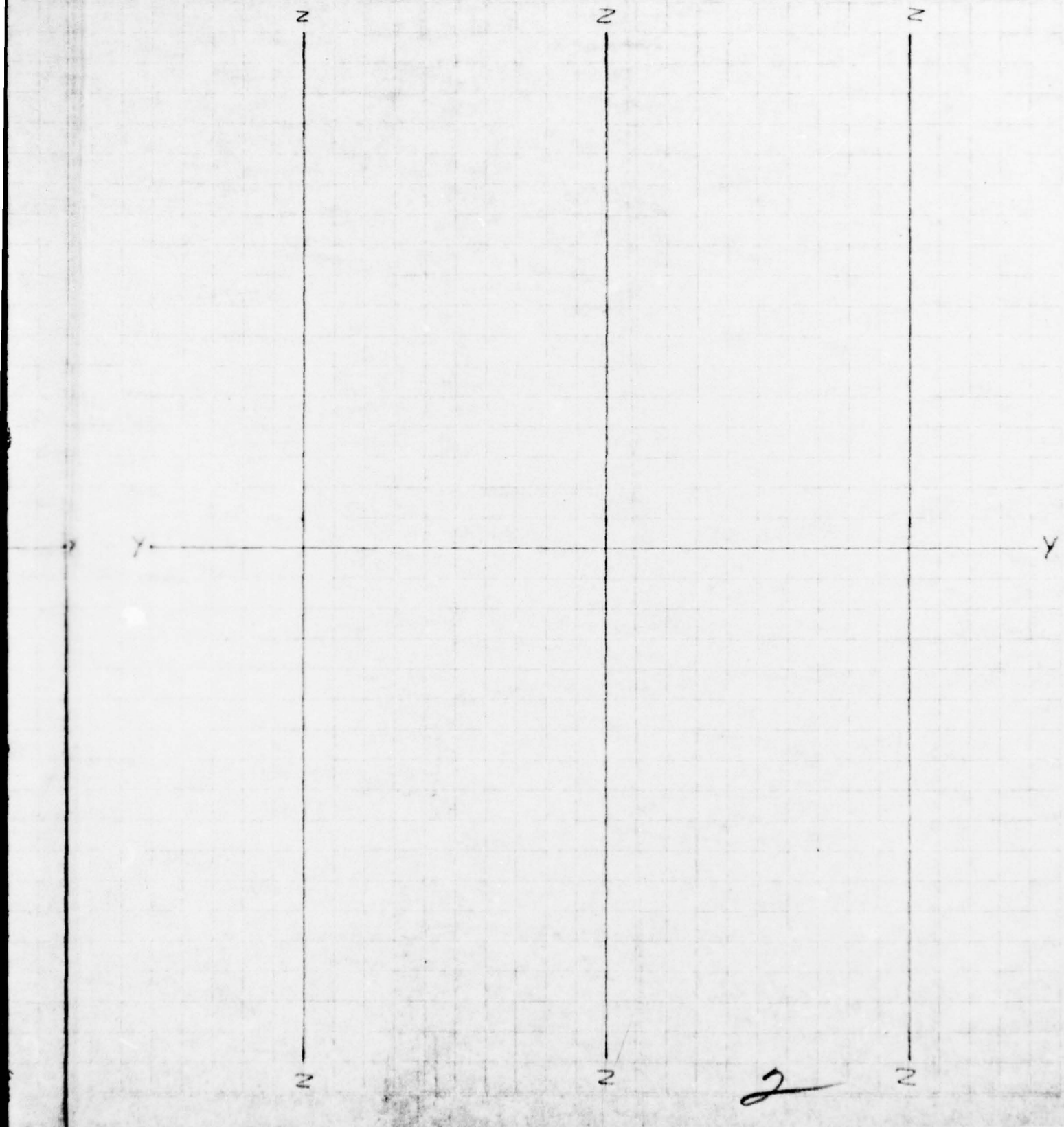
FOR RESONANT WAVE PERIOD



70,000 DWT LIGHT

0° HEADING

ORBITS PLOTTED FOR BUOY LOCATION (½L+100') 1" = 5'



2

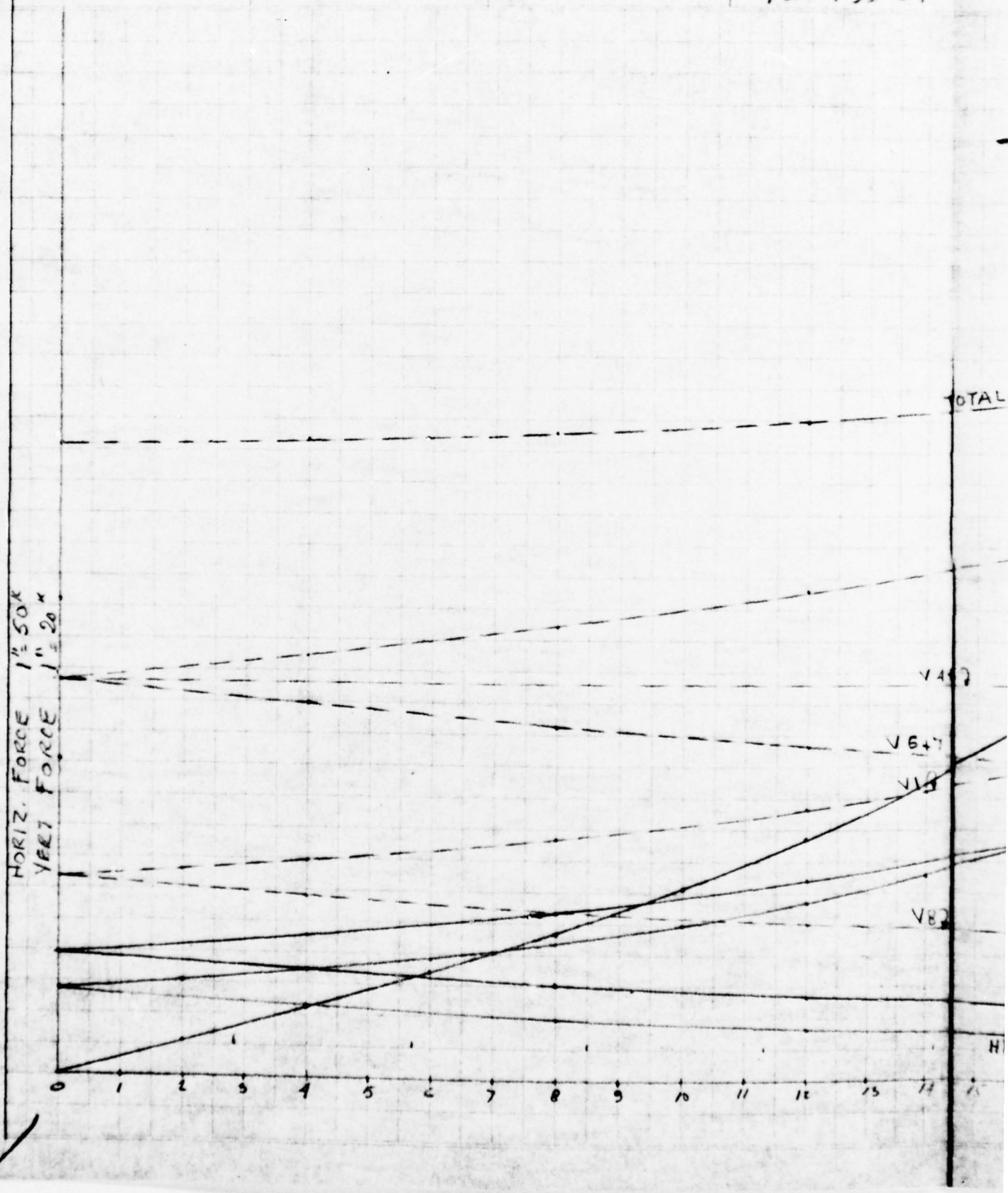
SECTION III

ANCHOR CHAIN FORCES

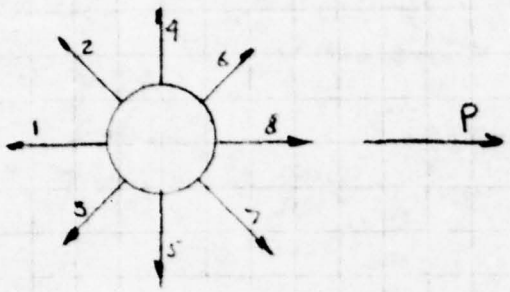
ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO. 23
SUBJECT: VERT & HORIZ ANCHOR FORCES FOR 15' WATER DEPTH			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 12-13-65



ANCHOR FORCES IN 150' WD



TOTAL V 1" = 50K

TOTAL H

V2+3

V1

V6+7

V8

H1

H2+3

H6+7

H8

ESTIMATION

OF

BUOY SIZE

SECTION IV

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY MCDERMOTT & CO., INC.

COMPANY			SHEET NO
SUBJECT: ESTIMATION OF BUOY SIZE FOR MOTION STUDY			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 12-15-65

ESTIMATION OF BUOY SIZE REQ'D

STEEL WT OF BUOY $\frac{2R^3}{15^3} \times 166.3 = 0.099\ R^3$ KIPS — 792 K

EQUIPMENT PIPING & FUEL — 126 K

BUMPER & CONTAINMENT — 60 K

ROLLER ASSEMBLY — 70 K

MAX PRETENSION — 250 K

SWIVEL — 25 K

1323

WT OF FOAM $\frac{1.25 \times \text{[illegible]}}{0.0615} \times 0.0025 =$ — 67 K

1,390 K

TOTAL WT OF BUOY & PRETENSION

TRY 36' ϕ → R=18

DISPL OF 36ϕ BUOY $13 \times 0.069 \times (1,618 - 574) + 2 \times 0.069 \times (2,463 - 1,011) = 784$ K

TOO SMALL TRY 38ϕ → R=19

DISPL OF 38ϕ BUOY $(14 \times (1,139 - 57) + 2 \times (2,492 - 1,139)) 0.069 = 1,158$

TOO SMALL TRY 40ϕ → R=20

DISPL OF 40ϕ BUOY $((15 \times (1,257 - 57) + 2 \times (2,527 - 1,257)) 0.069 = 1,353$ K OK

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 12-15-67

40' ϕ BUOY x 20' D

STEEL WT	792K	9		
ROTATING DECK	70K	21		
BUMPER + COUNTERWT	60K	27		
EQUIPMENT	126K	10		
SWIVEL	25K	19		
FOAM	67K	15		
	1,140K	KG = 11.4'	12,958	
			KB	
DISPL OF BUOY				
1' WL	0.069 x (2,827.4 - 56.7) x 1 =	177.3	0.5	88.7
1-2' WL	0.069 x (2,827.4 - 56.7) x 1 =	177.3	1.5	
Δ_2		354.6	KB = 1.00	354.6
2-4' WL	0.069 x (1,256.6 - 56.7) x 2 =	153.6	3	
Δ_4		508.2	KB = 1.60	813.4
4-6	0.069 x (1,256.6 - 56.7) x 2 =	153.6	5	
Δ_6		661.8	KB = 2.39	1,582.9
6-8	0.069 x (1,256.6 - 56.7) x 2 =	153.6	7	
Δ_8		815.4	KB = 3.26	2,658.6
8-10	0.069 x (1,256.6 - 56.7) x 2 =	153.6	9	
Δ_{10}		969.0	KB = 4.17	4,041.0
10-12	0.069 x (1,256.6 - 56.7) x 2 =	153.6	11	
Δ_{12}		1,122.6	KB = 5.10	5,730.6
12-14	x =	153.6	13	
Δ_{14}		1,276.2	KB = 6.06	7,727.9
14-16	=	153.6	15	
Δ_{16}		1,429.8	KB = 7.02	10,031.4
16-18		153.6	17	
Δ_{18}		1,583.4	KB = 7.98	12,642.6
18-20		153.6	19	
Δ_{20}		1,737.0	KB = 8.96	15,561.0

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 12-15-65

$I_{NL} = 0.049087 \times (70^4 - 9.5^4) \times 0.054 = 8,026''$

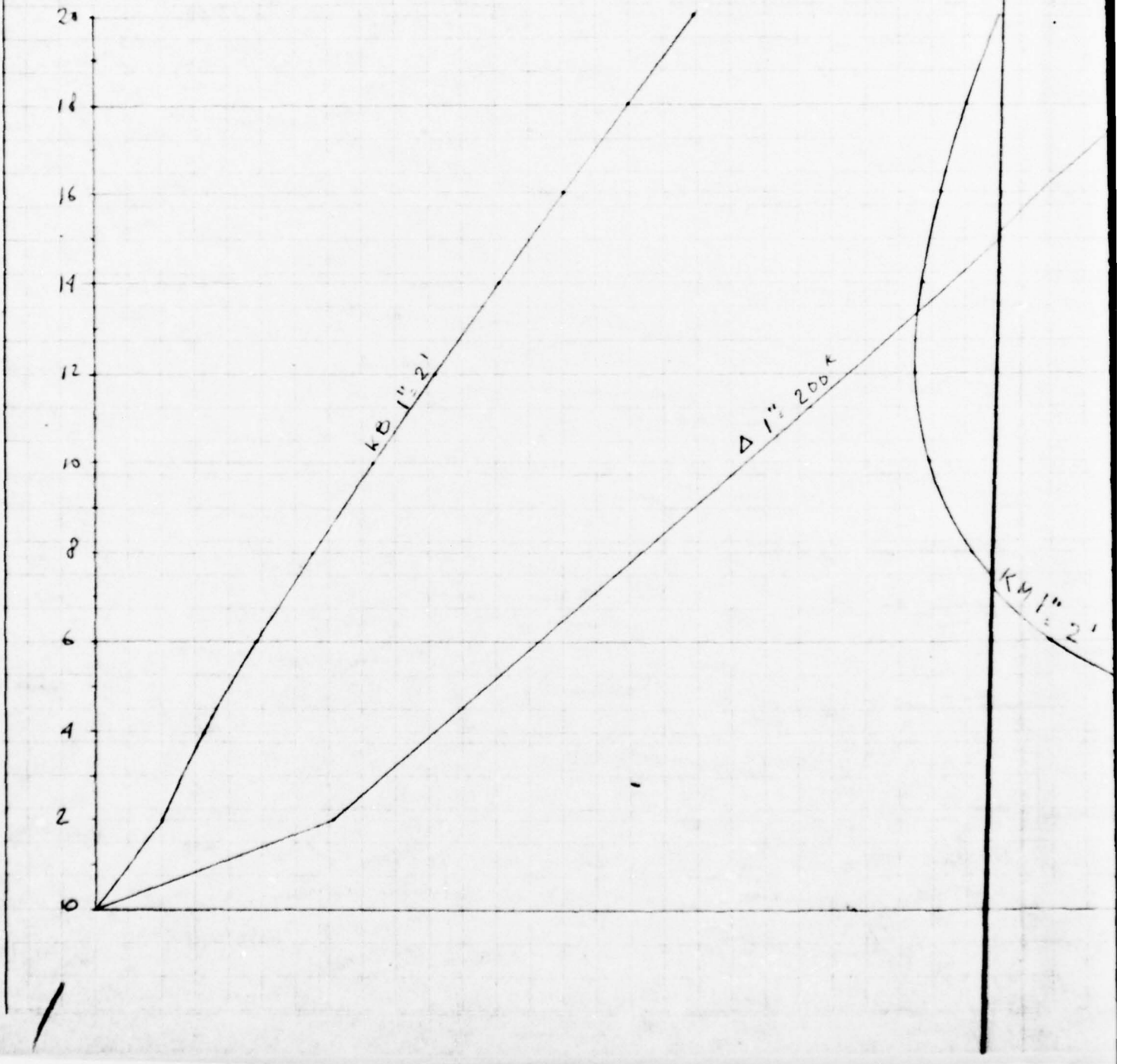
BM_4	$\frac{8,026}{508.2}$	15.79	BM_6	$\frac{8,026}{681.8}$	12.12
KB		1.60	KB		3.39
KM_4		17.39	KM_6		14.51
BM_8	$\frac{8,026}{915.4}$	9.84	BM_{10}	$\frac{8,026}{953.0}$	8.28
KB		3.26	KB		4.17
KM_8		13.10	KM_{10}		12.45
BM_{12}	$\frac{8,026}{1,122.6}$	7.19	BM_{14}	$\frac{8,026}{1,276.3}$	6.28
KB		5.10	KB		6.06
KM_{12}		12.29	KM_{14}		12.34
BM_{16}	$\frac{8,026}{1,429.8}$	5.61	BM_{18}	$\frac{8,026}{1583.4}$	5.06
KB		7.02	KB		7.98
KM_{16}		12.63	KM_{18}		13.04
BM_{20}	$\frac{8,026}{1,737.0}$	4.62			
KB		8.96			
KM_{20}		13.58			

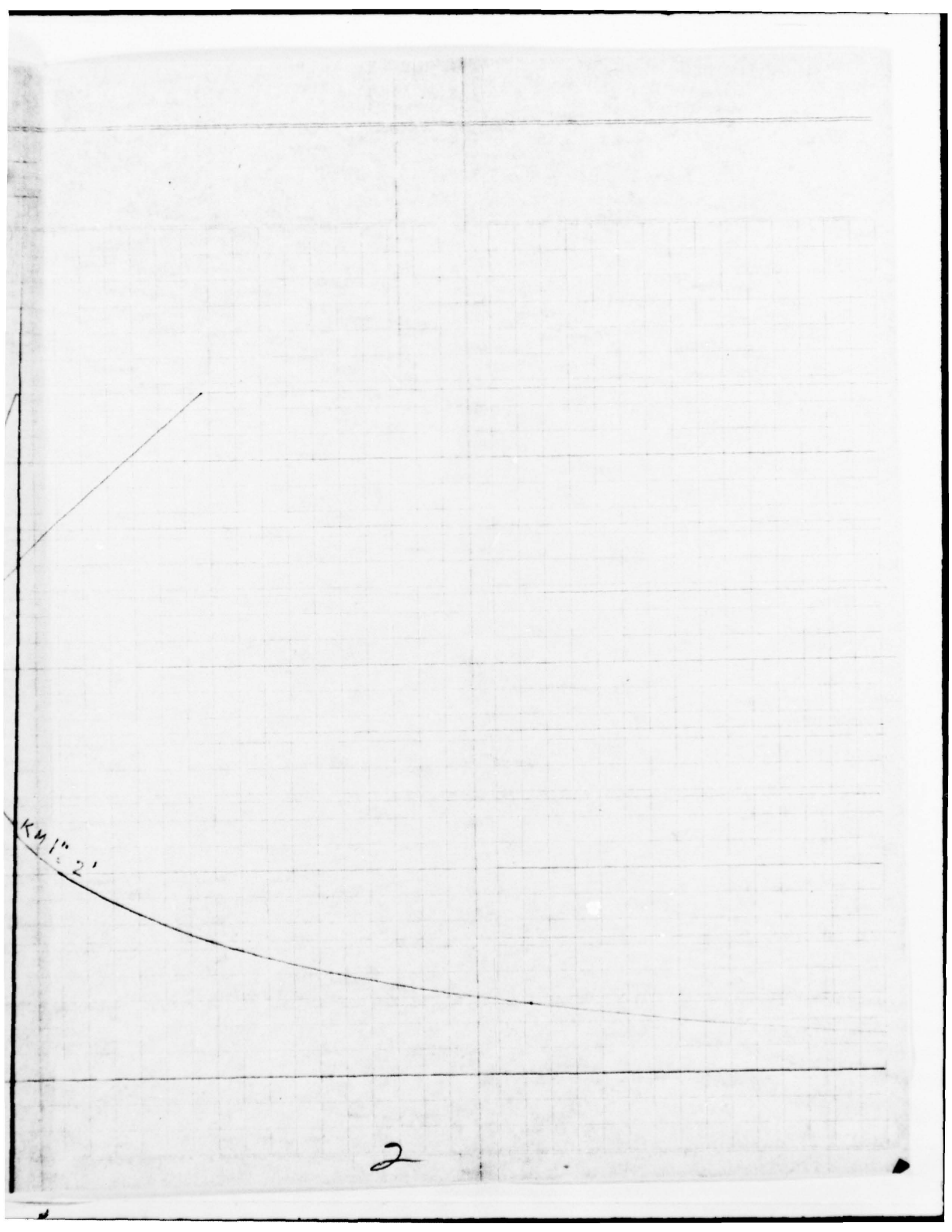
ENGINEERING DEPARTMENT
COMPUTATION SHEET

MCD 14003

J. RAY MCDERMOTT & CO., INC.

COMPANY			SHEET NO
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE

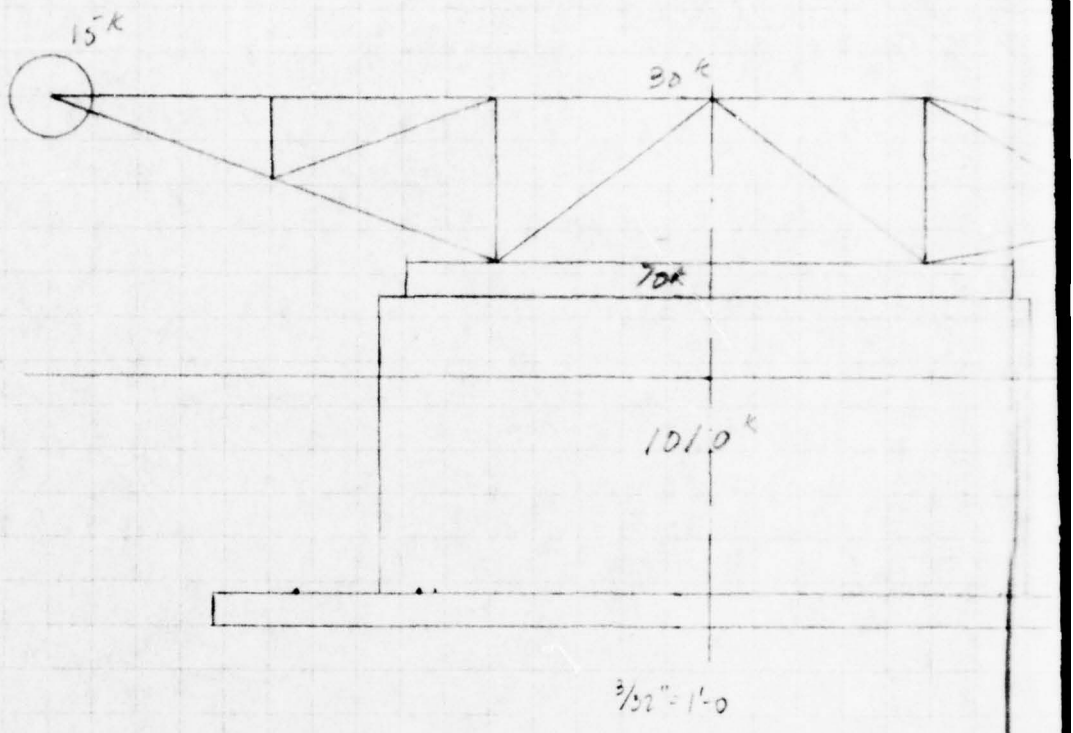


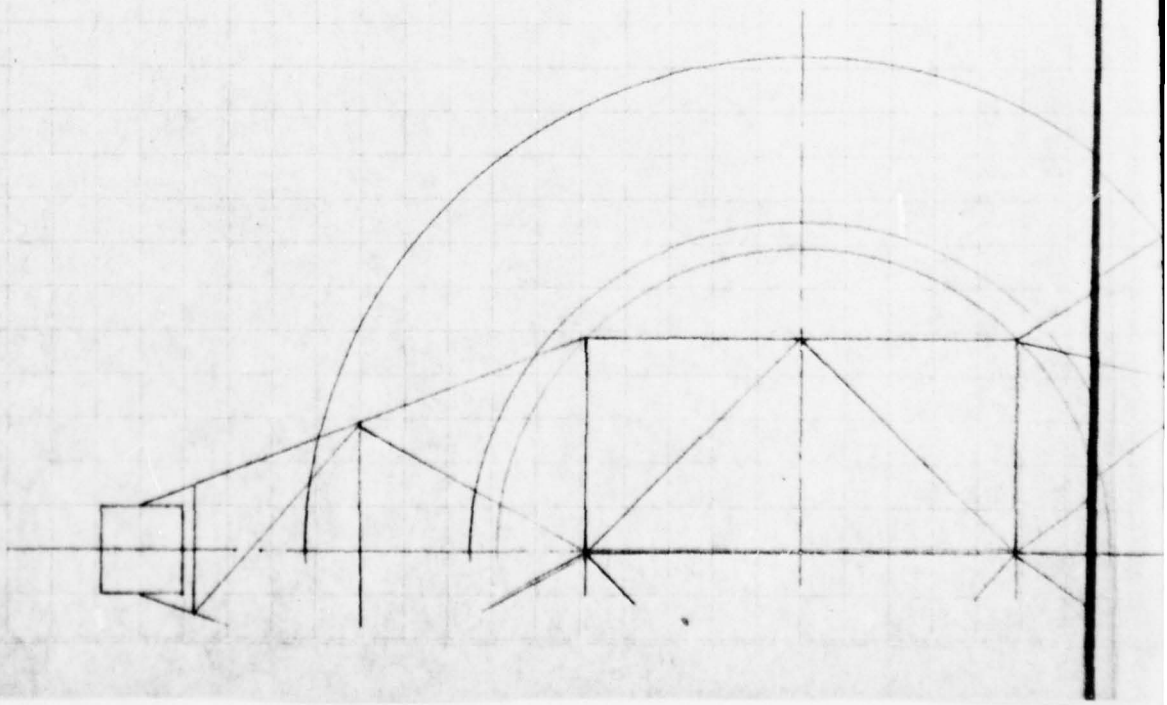

KM 1" = 2'

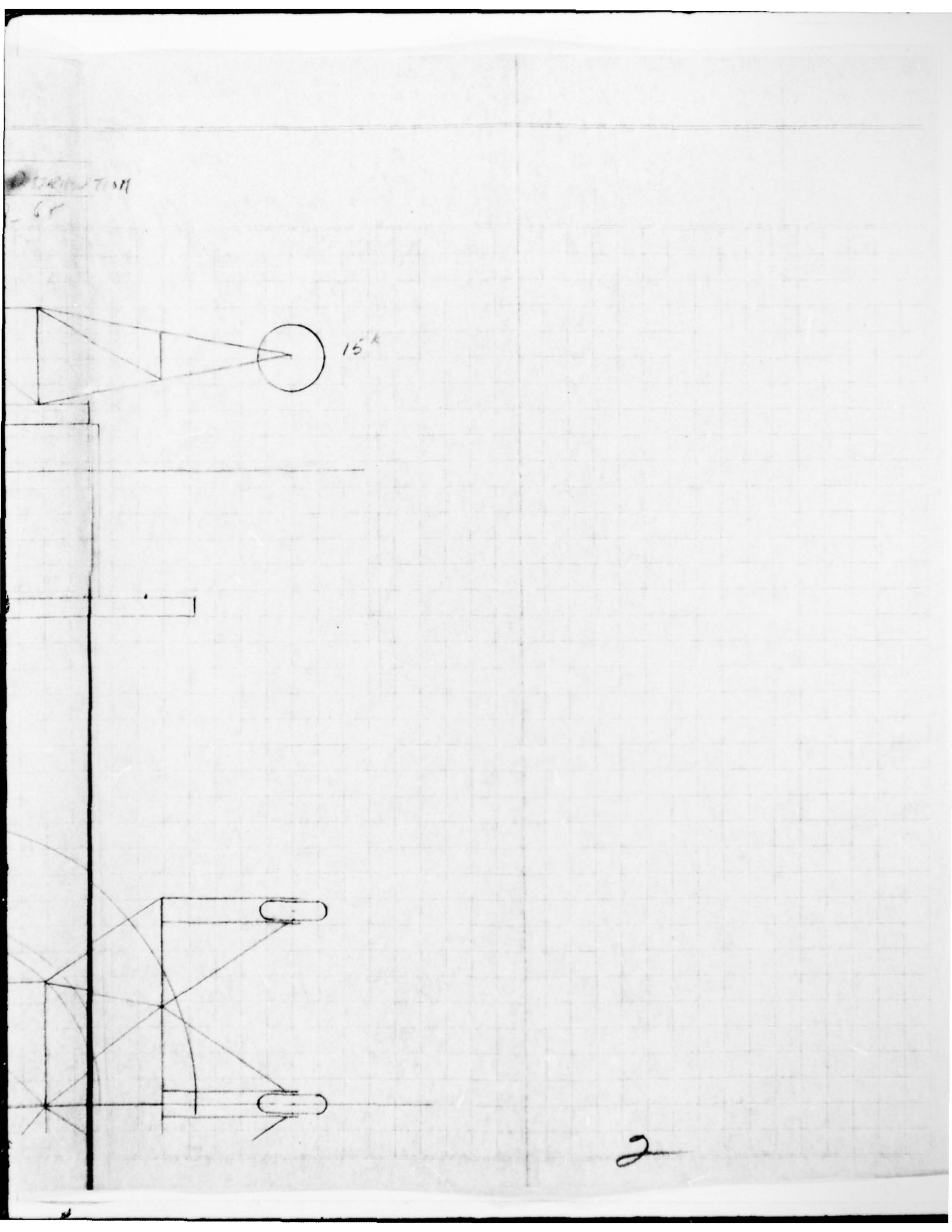
ENGINEERING DEPARTMENT
COMPUTATION SHEET
McD 14003

J. RAY MCDERMOTT & CO., INC.

COMPANY			SHEET NO
SUBJECT: ESTIMATED BUOY CONFIGURATION FOR MASS DETERMINATION			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE: 12-17-65



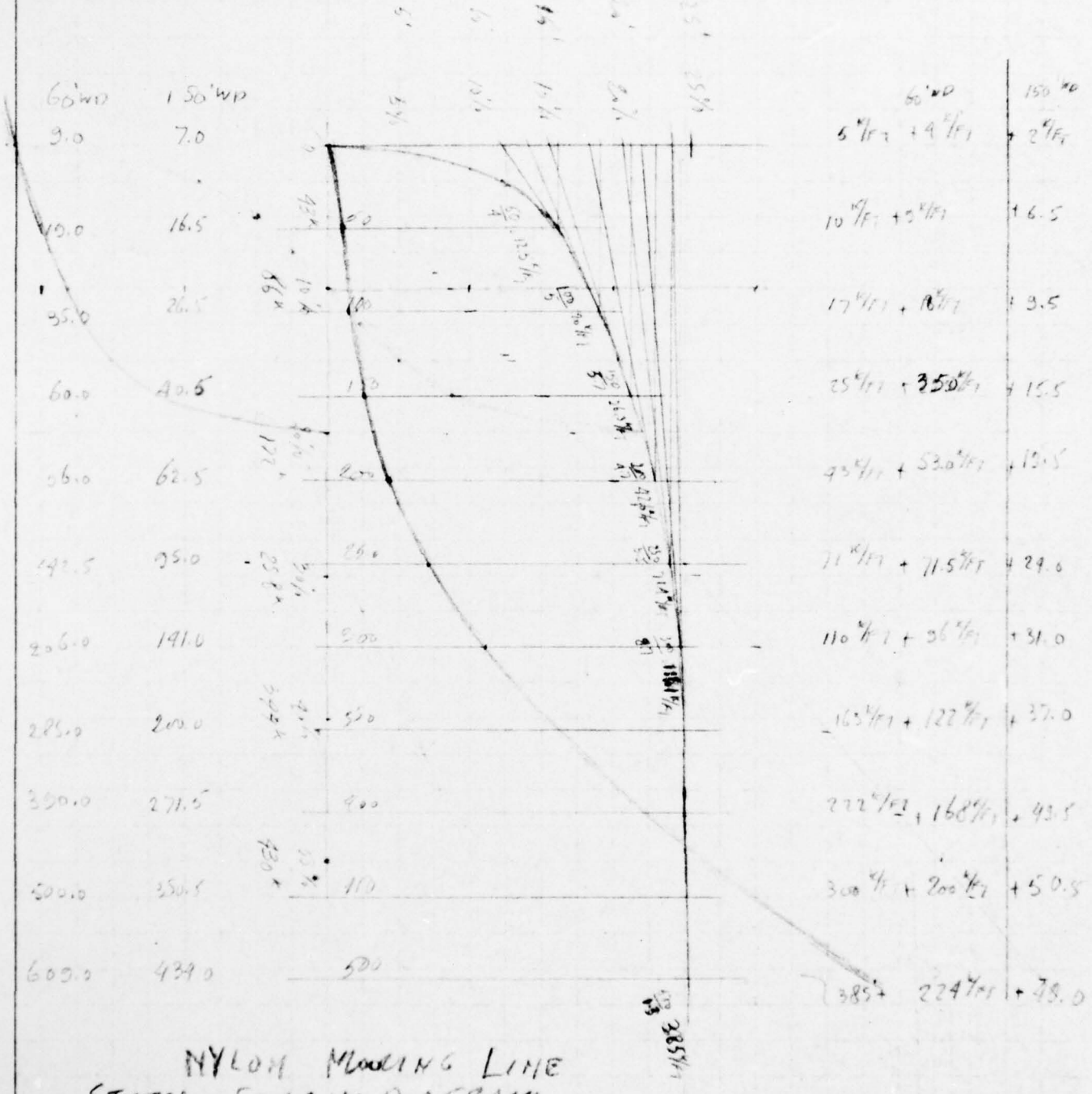



15"

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO.
SUBJECT: Chain + Mooring Line			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE



NYLON MOORING LINE
STRESS - STRAIN DIAGRAM

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 12-28-67

BOAT MOMENT OF INERTIA BUOY ROLL 150' WD

BUOY	$1010 \times 1/16 \times (40^2 + 4/3 \times 20^2) =$	139,665
ROTATING DECK	$70 \times 1/16 \times (32^2 + 4/3 \times 2^2) + 20 \times 10.3^2 =$	13,499
BUMP/COUNTWT	$30 \times 45^2 =$	60,750
FRAME	$\frac{30}{1140} \times 1/12 \times 80^2 =$	15,000
	J_{IN} 150' WD =	229,859
BALLAST	$\frac{162}{1302} \times 1/16 \times (40^2 + 4/3 \times 20^2) =$	21,500
	J_{IN} 60' WD =	246,459

POLAR MOMENT OF INERTIA BUOY PITCH 150' WD

BUOY		139,665
ROTATING DECK		13,499
BUMP/COUNT WT	$30 \times \left(\frac{40^2}{2} + 5^2\right)$	24,375
FRAME	$\frac{30}{1140} \times 1/12 \times \left(\left(\frac{40^2}{2} + \frac{2^2}{2}\right) + 10^2\right) =$	2,202
	J_{IN} 150' WD	179,761
BALLAST	$\frac{162}{1302} \times 1/16 \times (40^2 + 4/3 \times 20^2) =$	21,600
	J_{IN} 60' WD	136,361

K ROLL 150' WD = $\sqrt{\frac{229,859 + 325,409}{1140}} = \sqrt{482.68} = 21.97'$

K ROLL 60' WD = $\sqrt{\frac{246,459 + 325,409}{1302}} = \sqrt{439.21} = 20.96'$

K PITCH 150' WD = $\sqrt{\frac{179,761 + 325,409}{1140}} = \sqrt{438.74} = 20.95'$

K PITCH 60' WD = $\sqrt{\frac{136,361 + 325,409}{1302}} = \sqrt{400.79} = 20.02'$

VIRTUAL MASS HEAVE = 1,347 + 4,608 = 5,955^K IN 60' WD

VIRTUAL MASS HEAVE = 1,357 + 4,608 = 5,965^K IN 150' WD

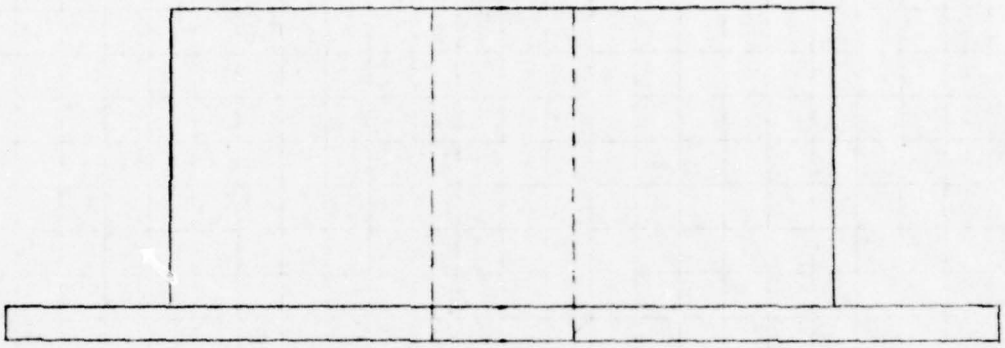
VIRTUAL MASS SURGE & SWAY = 1,397 × 2 = 2,694^K IN 60' WD

VIRTUAL MASS SURGE & SWAY = 1,357 × 2 = 2,714^K IN 150' WD

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY MCDERMOTT & CO., INC.

COMPANY			SHEET NO
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 12-28-65



ADDED MASS IN HEAVE $= \frac{8}{2} \times 0.064 \times 30^3 = 4,608$

ADDED MASS PITCH/ROLL $= \frac{16}{45} \times 0.064 \times 30^5 = 325,909$

ADDED MASS SURGE/SWAY: Δ

60' WD $\Delta_{MEAN} = 1,397.9^K$

150' WD $\Delta_{MEAN} = 1,357.0^K$

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

COMPANY | SHEET NO

SUBJECT: VARIATION OF DISPL. WITH HORIZ. MOORING LOAD

DRAWING NUMBER | COMPUTER | CHECKED BY | DATE 12-28-67

150' WD — all trims

	F_H	0.3 F_H	ΣV	W	Δ
2	13.6	4.1	252.9	1,140.0	1,388.3
4	27.5	8.3	253.1		1,389.8
6	42.7	12.8	254.9		1,381.6
8	58.9	17.7	256.3		1,378.6
10	76.6	23.0	258.5		1,375.5
12	96.1	28.8	261.5		1,372.7
14	117.6	35.3	265.1		1,369.8
16	143.0	42.9	269.7		1,366.8
18	173.2	52.0	275.6		1,363.6
20	210.7	63.2	283.1		1,359.9
22	258.0	77.4	291.5		1,354.1
24	317.3	95.2	303.1		1,347.9
26	394.7	118.4	317.5		1,339.1
28	494.8	148.4	334.1		1,325.7

60' WD

2	8.2	2.5	89.5	1302.0	1,389.0
4	17.9	5.4	90.5		1,387.1
6	27.8	8.3	92.0		1,385.7
8	39.5	11.9	94.7		1,389.8
10	53.0	17.1	98.6		1,383.5
11	68.0	20.4	101.1		1382.7
12	81.9	24.6	103.9		1,381.3
13	97.9	29.4	107.7		1,380.3
14	120.0	36.0	112.2		1,378.2
15	147.7	44.3	117.7		1,375.4
16	189.3	56.8	129.4		1,369.6
17	250.2	75.1	1329		1,359.8
18	393.5	103.1	144.9		1,343.8
19	530.8	159.2	162.9	6%	1,305.7

VIRTUAL STABILITY CALCULATIONS

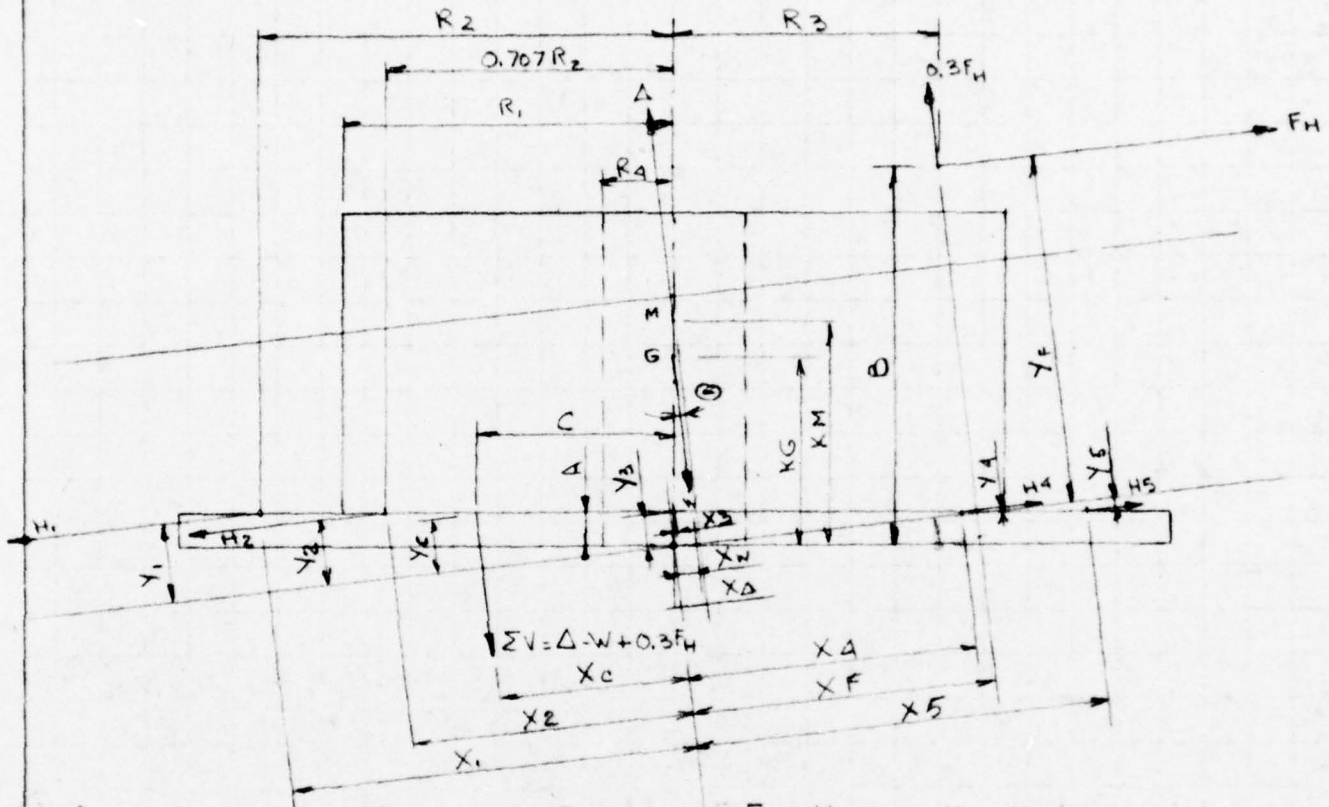
FOR BUOY

SECTION V

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 8015

J. RAY MCDERMOTT & CO., INC.

COMPANY			SHEET NO
SUBJECT: COMPUTER PROGRAM FOR VIRTUAL GM UNDER MOORING LOAD			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE



$\Delta = W + V_1 + V_2 + V_3 + V_4 + V_5 - 0.3 F_H$

$F_H = H_1 + H_2 - H_4 - H_5$

$$C = \frac{(V_1 - V_5) R_2 + (V_3 - V_4) 0.707 R_2}{V_1 + V_2 + V_3 + V_4 + V_5}$$

$$KM = \frac{0.05 (R_1^4 - R_4^4)}{\Delta} + \frac{(\Delta - 201.1)^7 + 153.6 \times 201.1}{153.6\ \Delta}$$

$X_3 = A \sin\theta$
$X_1 = R_2 \cos\theta - X_3$
$X_2 = 0.707 R_2 \cos\theta - X_3$
$X_C = C \cos\theta - X_3$
$X_4 = 0.707 R_2 \cos\theta + X_3$
$X_5 = R_2 \cos\theta + X_3$
$X_F = R_3 \cos\theta + B \sin\theta$
$X_W = KG \sin\theta$
$X_\Delta = KM \sin\theta$

$Y_3 = A \cos\theta$
$Y_1 = R_2 \sin\theta + Y_3$
$Y_2 = 0.707 R_2 \sin\theta + Y_3$
~~$Y_C = C \sin\theta + Y_3$~~
$Y_4 = 0.707 R_2 \sin\theta - Y_3$
$Y_5 = R_2 \sin\theta - Y_3$
$Y_F = R_3 \cos\theta + B \sin\theta$

$Y_F = B \cos\theta - R_3 \sin\theta$

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY MCDERMOTT & CO., INC.

COMPANY	SHEET NO
SUBJECT	

DRAWING NUMBER	COMPUTER	CHECKED BY	DATE

COMPUTER INPUT

R_1 = BUOY RADIUS = 20'
R_4 = WELL RADIUS = 4.25'
R_2 = ANCHOR CHAIN CONNECTING POINT RADIUS = 25'
R_3 = MOORING POINT RADIUS 16'
KG = 10.6' FOR 60' WD & 11.4' FOR 150' WD. CENTER OF GRAVITY ABOVE KEEL
W = WEIGHT OF BUOY = 1,302^k FOR 60' WD & 1,140^k FOR 150' WD
A = ANCHOR CHAIN CONNECTING POINT ABOVE KEEL = 2'
B = MOORING PORT ABOVE KEEL = 23'
H_{1-5} = HORIZ. ANCHOR FORCES V_{1-5} = VERT. ANCHOR FORCES

14 VALUES EACH

$$M = (\Delta - W + 0.3F_H)(-X_C) + (0.3F_H)(-X_F) + (W)(X_W) + (\Delta)(-X_\Delta) + \cancel{(0.3F_H)(-X_F)} + (F_H)(Y_F) + (H_1)(-Y_1) + (H_2)(-Y_2) + (H_4)(-Y_4) + (H_5)(-Y_5) + (1)(H_6) = 0$$

H_6: 0, 5, 10, 20, 40, 80 FOR EACH SET OF H_{1-5} V_{1-5}.

PRINT OUT W.D., F_H, ⊖ Angle

(or)

Δ

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

COMPANY | SHEET NO

SUBJECT: COMPUTER INPUT FOR VIRTUAL GM OF BUOY

DRAWING NUMBER | COMPUTER H3 = 0.0 | CHECKED BY 150 WD | DATE 12-17-65

EXCURSION	HORIZ ANCHOR FORCES				VERTICAL ANCHOR FORCES				
	H_1	H_2	H_4	H_5	V_1	V_2	V_3	V_4	V_5
2	38.2	52.2	45.8	31.0	33.0	65.0	63.0	61.2	30.2
4	43.0	56.7	43.2	23.0	34.5	67.1	63.0	52.5	23.0
6	48.2	61.3	40.3	26.5	36.2	69.6	63.0	52.8	27.8
8	54.3	66.6	37.8	29.2	38.2	72.2	63.0	56.2	26.7
10	61.1	72.8	35.7	22.2	46.3	74.7	63.0	54.7	25.8
12	70.8	79.2	33.3	20.6	43.0	77.5	63.0	53.1	24.9
14	81.8	87.0	32.0	19.2	45.8	80.5	63.0	51.7	24.1
16	95.5	95.5	30.0	18.0	49.3	83.7	63.0	50.4	23.3
18	112.5	105.6	28.3	16.6	53.3	87.2	63.0	49.3	22.8
20	135.5	117.2	27.0	15.0	58.5	91.2	63.0	48.2	22.2
22	166.5	131.1	25.8	13.8	64.3	95.7	63.0	47.2	21.3
24	208.0	146.3	24.5	12.5	71.8	101.2	63.0	46.2	20.9
26	264.5	165.0	23.0	11.8	81.0	107.8	63.0	45.9	20.3
28	339.0	188.3	21.5	11.0	91.2	115.7	63.0	44.4	19.8

H3 = 0.0 60'WD

EXCURSION	HORIZ ANCHOR FORCES				VERTICAL ANCHOR FORCES				
	H_1	H_2	H_4	H_5	V_1	V_2	V_3	V_4	V_5
2	15.0	21.0	16.8	11.0	12.2	23.6	22.2	21.2	10.3
4	18.5	23.2	14.8	9.0	13.3	25.3	22.2	20.1	9.6
6	23.0	26.5	13.5	8.2	14.7	27.0	22.2	19.1	9.0
8	29.0	30.0	12.0	7.5	16.7	29.1	22.2	18.2	8.5
10	38.5	35.5	10.5	6.5	19.2	31.5	22.2	17.5	8.2
11	45.0	39.2	10.2	6.0	20.8	32.9	22.2	17.2	8.0
12	54.0	43.5	10.0	5.6	22.8	34.4	22.2	16.8	7.7
13	65.5	47.5	9.8	5.3	25.3	36.2	22.2	16.5	7.5
14	80.5	54.0	9.5	5.0	28.2	38.2	22.2	16.3	7.3
15	101.5	60.0	9.2	4.6	32.0	40.3	22.2	16.0	7.2
16	134.5	67.5	8.5	4.2	36.6	42.8	22.2	15.7	7.1
17	185.5	76.5	8.3	3.5	42.7	45.7	22.2	15.4	6.9
18	267.0	87.5	8.0	3.0	51.6	49.2	22.2	15.1	6.8
19	390.0	101.0	7.7	2.5	66.2	53.0	22.2	14.8	6.7

J. RAY MC DERMOTT CO., INC. ENGINEERS AND GENERAL CONTRACTORS NEW ORLEANS, LA.

A= 2.0000 B= 23.0000 R1= 20.0000 R2= 25.0000 R3= 16.00
WATER DEPTH 150.00 FEET. CENTER OF GRAVITY 11.40 FEET ABOVE KEEL.

V1=	33.00	V2= 65.00	V3= 63.00	V4= 61.20	V5=	30.
H1=	38.20	H2= 52.20	H3= 0.00	H4= 45.80	H5=	31.
H6=	0.00	5.00	10.00	20.00	40.00	80.00
ANGLE	.60	.80	1.00	1.40	2.10	3.60
V1=	34.50	V2= 67.10	V3= 63.00	V4= 59.50	V5=	29.
H1=	43.00	H2= 56.70	H3= 0.00	H4= 43.20	H5=	29.
H6=	0.00	5.00	10.00	20.00	40.00	80.00
ANGLE	1.20	1.40	1.60	2.00	2.70	4.10
V1=	36.20	V2= 69.60	V3= 63.00	V4= 57.80	V5=	27.
H1=	48.20	H2= 61.30	H3= 0.00	H4= 40.30	H5=	26.
H6=	0.00	5.00	10.00	20.00	40.00	80.00
ANGLE	1.90	2.00	2.20	2.50	3.20	4.60
V1=	38.20	V2= 72.20	V3= 63.00	V4= 56.20	V5=	26.
H1=	54.30	H2= 66.60	H3= 0.00	H4= 37.80	H5=	24.
H6=	0.00	5.00	10.00	20.00	40.00	80.00
ANGLE	2.50	2.60	2.80	3.10	3.80	5.10
V1=	40.30	V2= 74.70	V3= 63.00	V4= 54.70	V5=	25.
H1=	61.70	H2= 72.80	H3= 0.00	H4= 35.70	H5=	22.
H6=	0.00	5.00	10.00	20.00	40.00	80.00
ANGLE	3.20	3.30	3.50	3.80	4.40	5.60
V1=	43.00	V2= 77.50	V3= 63.00	V4= 53.10	V5=	24.
H1=	70.80	H2= 79.20	H3= 0.00	H4= 33.30	H5=	20.
H6=	0.00	5.00	10.00	20.00	40.00	80.00
ANGLE	3.80	4.00	4.10	4.40	5.00	6.10
V1=	45.80	V2= 80.50	V3= 63.00	V4= 51.70	V5=	24.
H1=	81.80	H2= 87.00	H3= 0.00	H4= 32.00	H5=	19.
H6=	0.00	5.00	10.00	20.00	40.00	80.00
ANGLE	4.50	4.60	4.80	5.00	5.50	6.60
V1=	49.30	V2= 83.70	V3= 63.00	V4= 50.40	V5=	23.
H1=	95.50	H2= 95.50	H3= 0.00	H4= 30.00	H5=	17.
H6=	40.00	THETA= 1.7000	SUMMNT= 926.6998			
H6=	40.00	THETA= 1.8000	SUMMNT= 906.0107			
H6=	40.00	THETA= 1.9000	SUMMNT= 885.3196			
H6=	40.00	THETA= 2.0000	SUMMNT= 864.6264			
H6=	40.00	THETA= 2.1000	SUMMNT= 843.9310			
H6=	0.00	5.00	10.00	20.00	40.00	80.00
ANGLE	5.20	5.30	5.40	5.70	6.20	7.10
V1=	53.30	V2= 87.20	V3= 63.00	V4= 49.30	V5=	22.
H1=	112.50	H2= 105.60	H3= 0.00	H4= 28.30	H5=	16.
H6=	0.00	5.00	10.00	20.00	40.00	80.00
ANGLE	6.00	6.10	6.30	6.50	6.90	7.80
V1=	58.50	V2= 91.20	V3= 63.00	V4= 48.20	V5=	22.
H1=	135.50	H2= 117.20	H3= 0.00	H4= 27.00	H5=	15.
H6=	0.00	5.00	10.00	20.00	40.00	80.00
ANGLE	6.90	7.00	7.10	7.30	7.60	8.40

R2= 25.0000 R3= 16.0000 R4= 4.2500
11.40 FEET ABOVE KEEL. WEIGHT OF BUOY 1140.00 KIPS.

V4= 61.20 V5= 30.20
H4= 45.80 H5= 31.00 FH= 13.60
20.00 40.00 80.00
1.40 2.10 3.60

V4= 59.50 V5= 29.00
H4= 43.20 H5= 29.00 FH= 27.50
20.00 40.00 80.00
2.00 2.70 4.10

V4= 57.80 V5= 27.80
H4= 40.30 H5= 26.50 FH= 42.70
20.00 40.00 80.00
2.50 3.20 4.60

V4= 56.20 V5= 26.70
H4= 37.90 H5= 24.20 FH= 58.90
20.00 40.00 80.00
3.10 3.80 5.10

V4= 54.70 V5= 25.80
H4= 35.70 H5= 22.20 FH= 76.60
20.00 40.00 80.00
3.80 4.40 5.60

V4= 53.10 V5= 24.20
H4= 33.30 H5= 20.60 FH= 96.10
20.00 40.00 80.00
4.40 5.00 6.10

V4= 51.70 V5= 24.10
H4= 32.00 H5= 19.20 FH= 117.60
20.00 40.00 80.00
5.00 5.50 6.60

V4= 50.40 V5= 23.00
H4= 30.00 H5= 17.00 FH= 143.00
.6998
.0107
.3196
.6264
.9310
20.00 40.00 80.00
5.70 6.20 7.10

V4= 49.30 V5= 22.80
H4= 28.30 H5= 16.60 FH= 173.20
20.00 40.00 80.00
6.50 6.90 7.80

V4= 48.20 V5= 22.20
H4= 27.00 H5= 15.00 FH= 210.70
20.00 40.00 80.00
7.30 7.60 8.40

2

V1=	64.30	V2=	95.70	V3=	63.00 V4= 47.20 V5=
H1=	166.50	H2=	131.10	H3=	0.00 H4= 25.80 H5=
H6=	0.00		5.00	10.00	20.00 40.00
ANGLE	7.80		7.90	8.00	8.10 8.50
V1=	71.80	V2=	101.20	V3=	63.00 V4= 46.20 V5=
H1=	208.00	H2=	146.30	H3=	0.00 H4= 24.50 H5=
H6=	0.00		5.00	10.00	20.00 40.00
ANGLE	8.70		8.80	8.80	9.00 9.30
V1=	81.00	V2=	107.80	V3=	63.00 V4= 45.40 V5=
H1=	264.60	H2=	165.00	H3=	0.00 H4= 23.00 H5=
H6=	0.00		5.00	10.00	20.00 40.00
ANGLE	9.60		9.70	9.80	9.90 10.10
V1=	91.20	V2=	115.70	V3=	63.00 V4= 44.40 V5=
H1=	339.00	H2=	188.30	H3=	0.00 H4= 21.50 H5=
H6=	0.00		5.00	10.00	20.00 40.00
ANGLE	10.60		10.70	10.70	10.80 11.00

0	V4=	47.20	V5=	21.30	
0	H4=	25.80	H5=	13.80	FH= 258.00
	20.00	40.00		80.00	
	8.10	8.50		9.20	
0	V4=	46.20	V5=	20.90	
0	H4=	24.50	H5=	12.50	FH= 317.30
	20.00	40.00		80.00	
	9.00	9.30		9.90	
0	V4=	45.40	V5=	20.30	
0	H4=	23.00	H5=	11.80	FH= 394.70
	20.00	40.00		80.00	
	9.90	10.10		10.60	
0	V4=	44.40	V5=	19.80	
0	H4=	21.50	H5=	11.00	FH= 494.80
	20.00	40.00		80.00	
	10.80	11.00		11.50	

ENGINEERING DEPARTMENT
COMPUTATION SHEET
M-D 5015

J. RAY MCDERMOTT & CO., INC.

COMPANY | SHEET NO

SUBJECT: VIRTUAL GM FROM COMPUTER OUTPUT

DRAWING NUMBER | COMPUTER | CHECKED BY | DATE: 1-3-66

150' WD

2' EXCURSION — F_H = 13.6 — $0.3 F_H = F_V$ = 4.1 — Δ = 1,388.3

ADDED MOM	0.0	25.0	50.0	100.0	200.0	400.0
$d\theta$	0.0	0.2	0.4	0.8	1.5	3.0
SIN $d\theta$	0.0	0.00349	0.00698	0.01396	0.02618	0.05234
$GM_v = \frac{M}{\Delta \sin d\theta}$		5.15	5.15	5.15	5.50	5.50

28' EXCURSION — F_H = 494.8 — $0.3 F_H = F_V$ = 148.4 — Δ = 1,325.7

ADDED MOM	0.0	25.0	50.0	100.0	200.0	400.0
$d\theta$	0.0	0.10	0.10	0.20	0.40	0.90
SIN $d\theta$	0.0	0.00174	0.00174	0.00349	0.00698	0.01571
$GM_v = \frac{M}{\Delta \sin d\theta}$ =		10.62	21.64	21.59	21.62	19.20

4' EXCURSION — F_H = 27.5 — $0.3 F_H = F_V$ = 8.3 — Δ = 1384.8

ADDED MOM	25.0	50.0	100.0	200.0	400.0
$d\theta$	0.2	0.4	0.8	1.5	2.9
SIN $d\theta$	0.00349	0.00698	0.01396	0.02618	0.05059
$GM_v = \frac{M}{\Delta \sin d\theta}$ =	5.17	5.17	5.17	5.51	5.70

6' EXCURSION — F_H = 42.7 — $0.3 F_H = F_V$ = 12.8 — Δ = 1,381.6

ADDED MOM	25.0	50.0	100.0	200.0	400.0
$d\theta$	0.1	0.3	0.6	1.3	2.7
SIN $d\theta$	0.00174	0.00524	0.01047	0.02269	0.04711
$GM_v = \frac{M}{\Delta \sin d\theta}$ =	10.4	6.90	6.91	6.37	6.14

8' EXCURSION — F_H = 58.9 — $0.3 F_H = F_V$ = 17.7 — Δ = 1378.6

ADDED MOM	25.0	50.0	100.0	200.0	400.0
$d\theta$	0.1	0.3	0.6	1.3	2.6
SIN $d\theta$	0.00174	0.00524	0.01047	0.02269	0.04536
$GM_v = \frac{M}{\Delta \sin d\theta}$	10.40	6.92	6.93	6.39	6.39

10' EXCURSION — F_H = 76.6 — $0.3 F_H = F_V$ = 23.0 — Δ = 1375.5

ADD MOM	25.0	50.0	100.0	200.0	400.0
$d\theta$	0.1	0.3	0.6	1.2	2.4
SIN $d\theta$	0.00174	0.00524	0.01047	0.02099	0.04187
$GM_v = \frac{M}{\Delta \sin d\theta}$ =	10.46	6.93	6.94	6.94	6.94

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MOD 5015

J. RAY McDERMOTT & CO., INC.

COMPANY				SHEET NO
SUBJECT				
DRAWING NUMBER	COMPUTER		CHECKED BY	DATE 1-3-66

12' EXCURSION	F_H = 96.1	$0.3F_H$ =	F_V = 28.8	Δ = 1372.7	
ADDED MOM	25.0	50.0	100.0	200.0	400.0
$d\theta$ =	0.2	0.3	0.6	1.2	2.3
SIN $d\theta$ =	0.00349	0.00524	0.01047	0.02034	0.04013
$GM_v = \frac{M}{\Delta \sin d\theta}$ =	5.21	6.95	6.95	6.95	7.26
14' EXCURSION	F_H = 117.6	$0.3F_H$ =	F_V = 35.3	Δ = 1369.8	
ADD. MOM	25.0	50.0	100.0	200.0	400.0
$d\theta$ =	0.1	0.3	0.5	1.0	2.1
SIN $d\theta$ =	0.00174	0.00524	0.00873	0.01745	0.03669
$GM_v = \frac{M}{\Delta \sin d\theta}$ =	10.50	6.96	8.36	8.36	7.96
16' EXCURSION	F_H = 143.0	$0.3F_H$ =	F_V = 42.9	Δ = 1,366.6	
ADD MOM	25.0	50.0	100.0	200.0	400.0
$d\theta$ =	0.1	0.2	0.5	1.0	1.9
SIN $d\theta$ =	0.00174	0.00349	0.00873	0.01745	0.03315
$GM_v = \frac{M}{\Delta \sin d\theta}$ =	10.50	10.48	8.38	8.38	8.82
18' EXCURSION	F_H = 173.2	$0.3F_H$ =	F_V = 52.0	Δ = 1,363.6	
ADD MOM	25.0	50.0	100.0	200.0	400.0
$d\theta$ =	0.10	0.30	0.5	0.9	1.8
SIN $d\theta$ =	0.00174	0.00524	0.00873	0.01571	0.03141
$GM_v = \frac{M}{\Delta \sin d\theta}$ =	10.34	6.99	8.40	9.33	9.33
20' EXCURSION	F_H = 210.7	$0.3F_H$ =	F_V = 63.2	Δ = 1,359.9	
ADD MOM	25.0	50.0	100.0	200.0	400.0
$d\theta$ =	0.1	0.2	0.4	0.7	1.5
SIN $d\theta$ =	0.00174	0.00349	0.00698	0.01222	0.02618
$GM_v = \frac{M}{\Delta \sin d\theta}$ =	10.54	10.52	10.53	12.03	11.23
22' EXCURSION	F_H = 258.0	$0.3F_H$ =	F_V = 77.4	Δ = 1,354.1	
ADD MOM	25.0	50.0	100.0	200.0	400.0
$d\theta$ =	0.1	0.2	0.3	0.7	1.4
SIN $d\theta$ =	0.00174	0.00349	0.00524	0.01222	0.02443
$GM_v = \frac{M}{\Delta \sin d\theta}$ =	10.59	10.57	14.08	12.08	12.09

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY MCDERMOTT & CO., INC.

COMPANY			SHEET NO
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 1-3-66

24' EXCURSION F_H = 317.3 $0.3F_H$ = F_V = 95.2 Δ = 1,347.9

ADD MOM	25.0	50.0	100.0	200.0	400.0
$d\theta$	0.1	0.2	0.3	0.6	1.2
SIN $d\theta$	0.00174	0.00349	0.00524	0.01047	0.02094
$GM_V = \frac{M}{\Delta \sin d\theta}$	10.63	10.63	14.16	14.17	14.16

26' EXCURSION F_H = 394.7 $0.3F_H$ F_V = 118.4 Δ = 1,339.1

ADD MOM	25.0	50.0	100.0	200.0	400.0
$d\theta$	0.1	0.2	0.3	0.5	1.0
SIN $d\theta$	0.00174	0.00349	0.00524	0.00873	0.01745
$GM_V = \frac{M}{\Delta \sin d\theta}$	10.72	10.70	14.24	17.10	17.11

EXCURSION	F_H	GM_V MEAN
2	13.6	5.29
4	27.5	5.34
6	42.7	7.34 — 6.58
8	58.9	7.60 — 6.65
10	76.6	7.67 — 6.94
12	96.1	6.66 — 7.02
14	117.6	8.92 — 7.91
16	143.0	9.31
18	173.2	8.91 — 9.40
20	210.7	10.97 — 10.10
22	258.0	12.28 — 11.33
24	317.3	12.75
26	394.7	13.97
28	494.8	21.01

SECTION VI

MOTION STUDY

FOR BUOY

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO
SUBJECT: ROLL & PITCH PERIOD VARIATION WITH MOORING LOAD			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 1-4-66

150' WD

PERIOD OF ROLL = $\frac{1.108\,K}{\sqrt{GM_v}} = \frac{1.108 \times 21.97}{\sqrt{5}} = \frac{24.34}{2.24} = 10.87$ SEC

PERIOD OF PITCH

Horiz Mooring Load		
0	$\frac{1.108 \times 20.9^2}{2.24} = \frac{23.21}{2.24}$	10.36 SEC
50	$23.21/\sqrt[3]{6.28} = 23.21/2.51$	9.25 SEC
100	$23.21/\sqrt{7.55} = 23.21/2.75$	8.44 SEC
150	$23.21/\sqrt{8.3} = 23.21/2.97$	7.81 SEC
200	$23.21/\sqrt{10.15} = 23.21/3.19$	7.28 SEC
250	$23.21/\sqrt{11.45} = 23.21/3.38$	6.87 SEC
300	$23.21/\sqrt{12.75} = 23.21/3.57$	6.50 SEC
350	$23.21/\sqrt{14.05} = 23.21/3.75$	6.19 SEC
400	$23.21/\sqrt{15.35} = 23.21/3.92$	5.92 SEC
450	$23.21/\sqrt{11.65} = 23.21/4.08$	5.69 SEC
500	$23.21/\sqrt{18.0} = 23.21/4.24$	5.47 SEC

PERIOD OF SWAY = $\frac{2\pi}{\sqrt{\frac{g}{\Delta + \text{ADD MASS}}\,k}} = \frac{2\pi}{\sqrt{\frac{32.2 \times 2.0}{2.714}}} = \frac{6.28}{\sqrt{0.0831}} = \frac{6.28}{0.29} = 21.66$ SEC

PERIOD OF SURGE = $\frac{2\pi}{\sqrt{\frac{g}{2\Delta}\,k}}$

0	$6.28/\sqrt{0.0831} = 6.28/0.29$		21.66 SEC
50	$6.28/\sqrt{32.2 \times 105/2,714} = 6.28/\sqrt{0.1958}$	$6.28/0.44$	14.27 SEC
100	$6.28/\sqrt{32.2 \times 265/2,714} = 6.28/\sqrt{0.3144}$	$6.28/0.56$	11.21 SEC
150	$6.28/\sqrt{32.2 \times 405/2,714} = 6.28/\sqrt{0.4805}$	$6.28/0.69$	9.10 SEC
200	$6.28/\sqrt{32.2 \times 625/2,714} = 6.28/\sqrt{0.7415}$	$6.28/0.86$	7.30 SEC
250	$6.28/\sqrt{32.2 \times 950/2,714} = 6.28/\sqrt{1.1271}$	$6.28/1.06$	5.92 SEC
300	$6.28/\sqrt{32.2 \times 1410/2,714} = 6.28/\sqrt{1.6729}$	$6.28/1.29$	4.87 SEC
350	$6.28/\sqrt{32.2 \times 2000/2,714} = 6.28/\sqrt{2.3729}$	$6.28/1.54$	4.08 SEC
400	$6.28/\sqrt{32.2 \times 2715/2,714} = 6.28/\sqrt{3.2212}$	$6.28/1.79$	3.51 SEC
450	$6.28/\sqrt{32.2 \times 3505/2,714} = 6.28/\sqrt{4.1585}$	$6.28/2.04$	3.08 SEC
500	$6.28/\sqrt{32.2 \times 4340/2,714} = 6.28/\sqrt{5.1492}$	$6.28/2.27$	2.77 SEC

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

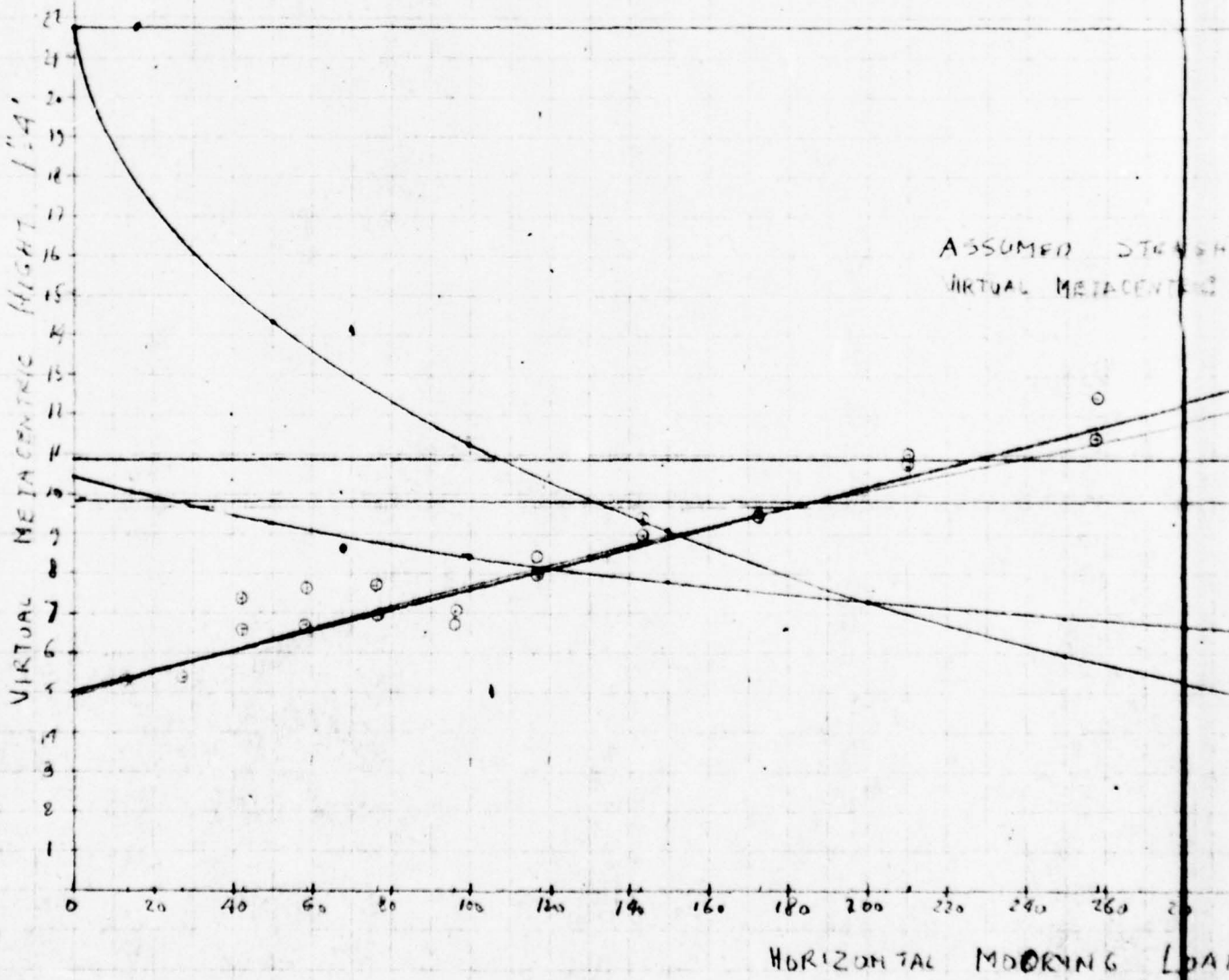
J. RAY McDERMOTT & CO., INC.

COMPANY | SHEET NO

SUBJECT: VIRTUAL GM OF BUOY VERSUS MOORING LOAD

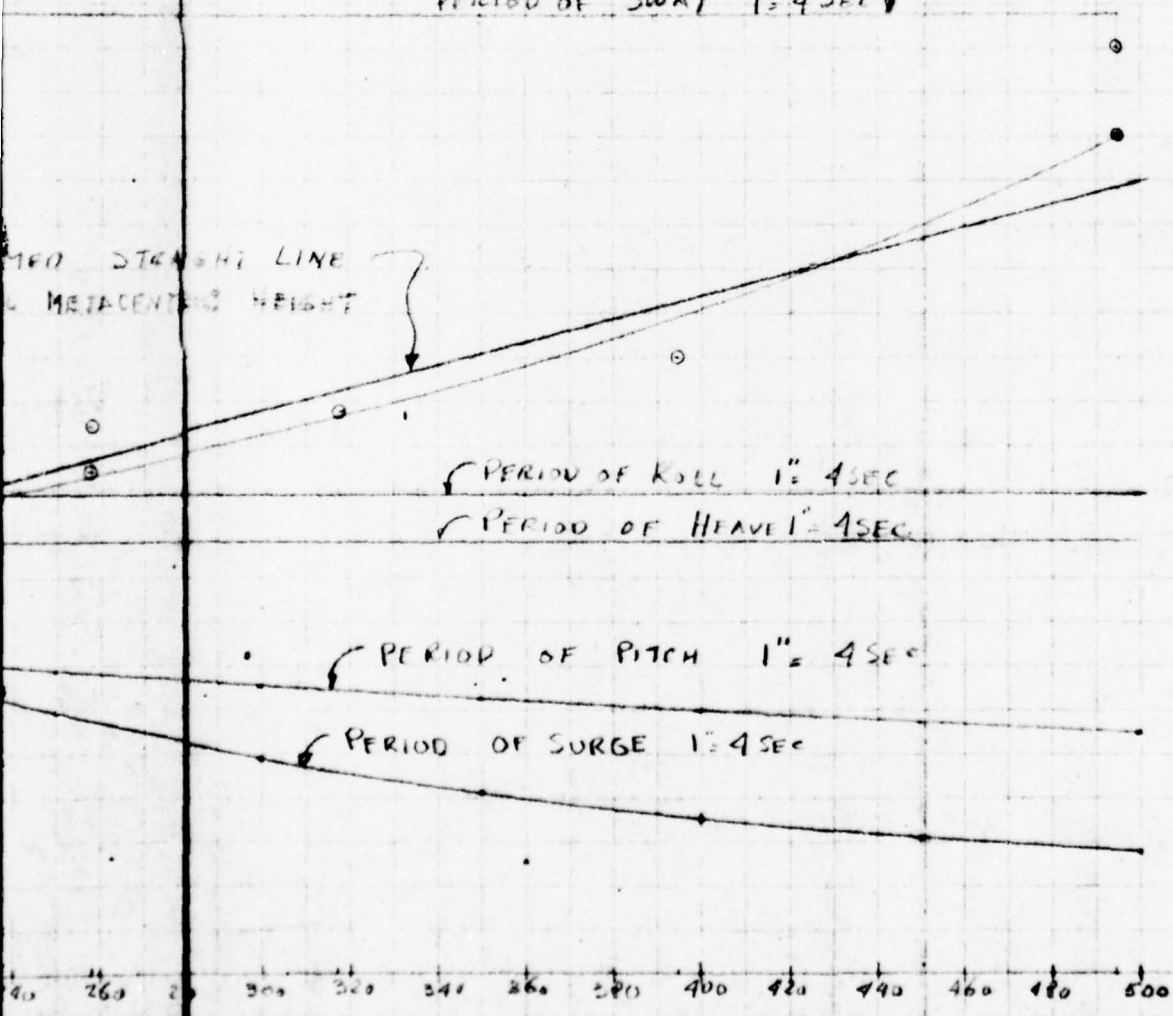
DRAWING NUMBER | COMPUTER | CHECKED BY | DATE: 1-3-66

AND NATURAL PERIODS



LOAD
66

VIRTUAL METACENTRIC HIGHT IN 150' WD



240 260 280 300 320 340 360 380 400 420 440 460 480 500

DRYING LOAD 1" = 40K

2

A= 2.0000 B= 23.0000 R1= 20.0000 R2= 25.0000 R3= 16.0000 R

WATER DEPTH 60.00 FEET. CENTER OF GRAVITY 10.60 FEET ABOVE KEEL. WEI

V1=	12.20	V2= 23.60	V3= 22.20	V4= 21.20	V5=	10.30
H1=	15.00	H2= 21.00	H3= 0.00	H4= 16.80	H5=	11.00 R
H6=	0.00	5.00	10.00	20.00	40.00	80.00
ANGLE	.50	.80	1.10	1.70	2.80	5.20
V1=	13.30	V2= 25.30	V3= 22.20	V4= 20.10	V5=	9.60
H1=	18.50	H2= 23.20	H3= 0.00	H4= 14.80	H5=	9.00 R
H6=	0.00	5.00	10.00	20.00	40.00	80.00
ANGLE	1.20	1.50	1.70	2.30	3.40	5.70
V1=	14.70	V2= 27.00	V3= 22.20	V4= 19.10	V5=	9.00
H1=	23.00	H2= 26.50	H3= 0.00	H4= 13.50	H5=	8.20 R
H6=	0.00	5.00	10.00	20.00	40.00	80.00
ANGLE	1.80	2.00	2.30	2.80	3.90	6.00
V1=	16.70	V2= 29.10	V3= 22.20	V4= 18.20	V5=	8.50
H1=	29.00	H2= 30.00	H3= 0.00	H4= 12.00	H5=	7.50 R
H6=	0.00	5.00	10.00	20.00	40.00	80.00
ANGLE	2.40	2.60	2.80	3.30	4.30	6.30

NEW ORLEANS, LA

00 R3= 16.0000 R4= 4.2500
T ABOVE KEEL. WEIGHT OF BUOY 1302.00 KIPS.

20 V5= 10.30
80 H5= 11.00 FH= 8.20
0.00 80.00
2.80 5.20

10 V5= 9.60
80 H5= 9.00 FH= 17.90
0.00 80.00
3.40 5.70

10 V5= 9.00
50 H5= 8.20 FH= 27.80
0.00 80.00
3.90 6.00

20 V5= 8.50
00 H5= 7.50 FH= 39.50
0.00 80.00
4.30 6.30

2

J. RAY MC DERMOTT CO., INC. ENGINEERS AND GENERAL CONTRACTORS NEW ORLEANS, LA.

A= 2.0000 B= 23.0000 R1= 20.0000 R2= 25.0000 R3= 16.0

WATER DEPTH 60.00 FEET. CENTER OF GRAVITY 10.60 FEET ABOVE KEEL.

V1=	19.20	V2=	31.50	V3=	22.20	V4=	17.50	V5=	
H1=	38.50	H2=	35.50	H3=	0.00	H4=	10.50	H5=	
H6=	0.00		5.00	10.00	20.00	40.00	80.0
ANGLE	3.50		3.70	4.00	4.40	5.30	7.0
V1=	20.80	V2=	32.90	V3=	22.20	V4=	17.20	V5=	
H1=	45.00	H2=	39.20	H3=	0.00	H4=	10.20	H5=	
H6=	0.00		5.00	10.00	20.00	40.00	80.0
ANGLE	4.10		4.30	4.50	5.00	5.80	7.4
V1=	22.80	V2=	34.40	V3=	22.20	V4=	16.80	V5=	
H1=	54.00	H2=	43.50	H3=	0.00	H4=	10.00	H5=	
H6=	0.00		5.00	10.00	20.00	40.00	80.0
ANGLE	4.80		5.00	5.20	5.60	6.30	7.9
V1=	25.30	V2=	36.20	V3=	22.20	V4=	16.50	V5=	
H1=	65.50	H2=	47.50	H3=	0.00	H4=	9.80	H5=	
H6=	0.00		5.00	10.00	20.00	40.00	80.0
ANGLE	5.50		5.70	5.80	6.20	6.90	8.3

.0000 R3= 16.0000 R4= 4.2500
FEET ABOVE KEEL. WEIGHT OF BUOY 1302.00 KIPS.

17.50 V5= 8.20
10.50 H5= 6.50 FH= 57.00
40.00 80.00
5.30 7.00

17.20 V5= 8.00
10.20 H5= 6.00 FH= 68.00
40.00 80.00
5.80 7.40

16.80 V5= 7.70
10.00 H5= 5.60 FH= 81.90
40.00 80.00
6.30 7.90

16.50 V5= 7.50
9.80 H5= 5.30 FH= 97.90
40.00 80.00
6.90 8.30

A= 2.0000 B= 23.0000 R1= 20.0000 R2= 25.0000 R3=
WATER DEPTH 60.00 FEET. CENTER OF GRAVITY 10.60 FEET ABOVE KE

V1=	28.20	V2= 38.20	V3= 22.20	V4=	16.30 V5=
H1=	80.50	H2= 54.00	H3= 0.00	H4=	9.50 H5=
H6=	0.00	5.00	10.00	20.00	40.00
ANGLE	6.40	6.60	6.70	7.00	7.70

V1=	32.00	V2= 40.30	V3= 22.20	V4=	16.00 V5=
H1=	101.50	H2= 60.00	H3= 0.00	H4=	9.20 H5=
H6=	0.00	5.00	10.00	20.00	40.00
ANGLE	7.40	7.50	7.60	7.90	8.50

V1=	36.60	V2= 42.80	V3= 22.20	V4=	15.70 V5=
H1=	134.50	H2= 67.50	H3= 0.00	H4=	8.50 H5=
H6=	0.00	5.00	10.00	20.00	40.00
ANGLE	8.60	8.80	8.90	9.10	9.60

V1=	42.70	V2= 45.70	V3= 22.20	V4=	15.40 V5=
H1=	185.50	H2= 76.50	H3= 0.00	H4=	8.30 H5=
H6=	0.00	5.00	10.00	20.00	40.00
ANGLE	10.00	10.10	10.20	10.40	10.80

V1=	51.60	V2= 49.20	V3= 22.20	V4=	15.10 V5=
H1=	267.00	H2= 87.50	H3= 0.00	H4=	8.00 H5=
H6=	0.00	5.00	10.00	20.00	40.00
ANGLE	11.50	11.60	11.60	11.80	12.10

V1=	66.20	V2= 53.00	V3= 22.20	V4=	14.80 V5=
H1=	440.00	H2= 101.00	H3= 0.00	H4=	7.70 H5=
H6=	0.00	5.00	10.00	20.00	40.00
ANGLE	13.30	13.40	13.40	13.50	13.80

0.0000 R2= 25.0000 R3= 16.0000 R4= 4.2500
RAVITY 10.60 FEET ABOVE KEEL. WEIGHT OF BUOY 1302.00 KIPS.

22.20	V4=	16.30	V5=	7.30	
0.00	H4=	9.50	H5=	5.00	FH= 120.00
	20.00	40.00		80.00	
	7.00	7.70		8.90	
22.20	V4=	16.00	V5=	7.20	
0.00	H4=	9.20	H5=	4.60	FH= 147.70
	20.00	40.00		80.00	
	7.90	8.50		9.60	
22.20	V4=	15.70	V5=	7.10	
0.00	H4=	8.50	H5=	4.20	FH= 189.30
	20.00	40.00		80.00	
	9.10	9.60		10.50	
22.20	V4=	15.40	V5=	6.90	
0.00	H4=	8.30	H5=	3.50	FH= 250.20
	20.00	40.00		80.00	
	10.40	10.80		11.60	
22.20	V4=	15.10	V5=	6.80	
0.00	H4=	8.00	H5=	3.00	FH= 343.50
	20.00	40.00		80.00	
	11.80	12.10		12.70	
22.20	V4=	14.80	V5=	6.70	
0.00	H4=	7.70	H5=	2.50	FH= 530.80
	20.00	40.00		80.00	
	13.50	13.80		14.20	

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

COMPANY | SHEET NO

SUBJECT: VIRTUAL GM FROM COMPUTER OUTPUT

DRAWING NUMBER | COMPUTER | CHECKED BY | DATE: 1-6-66

60 WD

2' EXCURSION		F_H = 8.2	F_V = 2.5		Δ = 1389.0
M of M	25.0	50.0	100.0	200.0	400.0
$d\theta$	0.3	.06	1.2	2.3	4.7
SIN $d\theta$ =	0.0052	0.0105	0.0209	0.0401	0.0819
$GM_v = \frac{M}{\Delta \sin d\theta}$ =	3.47	3.43	3.44	3.59	3.52
4' EXC		F_H = 17.9	F_V = 5.4	Δ = 1382.1	
M of M	25.0	50.0	100.0	200.0	400.0
$d\theta$	0.3	0.5	1.1	2.2	4.5
SIN $d\theta$ =	0.0052	0.0087	0.0192	0.0384	0.0785
$GM_v = \frac{M}{\Delta \sin d\theta}$ =	3.47	4.14	3.76	3.76	3.67
6' EXC		F_H = 27.8	F_V = 8.3	Δ = 1385.7	
M of M	25.0	50.0	100.0	200.0	400.0
$d\theta$	0.2	0.5	1.0	2.1	4.2
SIN $d\theta$ =	0.0047	0.0087	0.0175	0.0366	0.0782
$GM_v = \frac{M}{\Delta \sin d\theta}$ =	3.84	4.15	4.12	3.94	3.94
8' EXC		F_H = 39.5	F_V = 11.9	Δ = 1384.8	
M of M	25.0	50.0	100.0	200.0	400.0
$d\theta$	0.2	0.4	0.9	1.9	3.9
SIN $d\theta$ =	0.0047	0.0070	0.0157	0.0332	0.0680
$GM_v = \frac{M}{\Delta \sin d\theta}$ =	3.84	5.16	4.60	4.35	4.25
10' EXC		F_H = 57.0	F_V = 17.1	Δ = 1383.5	
M of M	25.0	50.0	100.0	200.0	400.0
$d\theta$	0.2	0.5	0.9	1.8	3.5
SIN $d\theta$ =	0.0047	0.0087	0.0157	0.0314	0.0610
$GM_v = \frac{M}{\Delta \sin d\theta}$ =	3.85	4.15	4.60	4.60	4.74
11' EXC		F_H = 68.0	F_V = 20.9	Δ = 1382.7	
M of M	25.0	50.0	100.0	200.0	400.0
$d\theta$ =	0.2	0.4	0.9	1.7	3.3
SIN $d\theta$ =	0.0047	0.0070	0.0157	0.0297	0.0576
$GM_v = \frac{M}{\Delta \sin d\theta}$ =	3.85	5.17	4.61	4.87	5.02

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY MCDERMOTT & CO., INC.

COMPANY			SHEET NO
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 1-6-66

12' Exc	F_H = 81.9	F_V = 24.6		Δ = 1381.3	
M o M	25.0	50.0	100.0	200.0	400.0
$d\theta$	0.2	0.4	0.8	1.5	3.1
$\sin d\theta$	0.0047	0.0070	0.0140	0.0262	0.0541
$GM_L = \frac{M}{\Delta \sin d\theta}$ =	3.85	5.17	5.17	5.53	5.35
13' Exc	F_H = 97.9	F_V = 29.4		Δ =	1380.3
M o M	25.0	50.0	100.0	200.0	400.0
$d\theta$	0.2	0.3	0.7	1.4	2.8
$\sin d\theta$	0.0047	0.0052	0.0122	0.0244	0.0488
$GM_L = \frac{M}{\Delta \sin d\theta}$ =	3.85	6.96	5.94	5.94	5.94
14' Exc	F_H = 120	F_V = 36.0		Δ =	1378.2
M o M	25.0	50.0	100.0	200.0	400.0
$d\theta$	0.2	0.3	0.6	1.3	2.5
$\sin d\theta$	0.0047	0.0052	0.0105	0.0227	0.0436
$GM_L = \frac{M}{\Delta \sin d\theta}$ =	3.86	6.97	6.91	6.39	6.66
15' Exc	F_H = 147.7	F_V = 49.3		Δ = 1375.4	
M o M	25.0	50.0	100.0	200.0	400.0
$d\theta$	0.1	0.2	0.5	1.1	2.2
$\sin d\theta$	0.0017	0.0035	0.0087	0.0192	0.0384
$GM_L = \frac{M}{\Delta \sin d\theta}$ =	10.68	10.10	8.35	7.57	7.57
16' Exc	F_H = 189.3	F_V = 56.8		Δ =	1362.6
M o M	25.0	50.0	100.0	200.0	400.0
$d\theta$	0.2	0.3	0.5	1.0	1.9
$\sin d\theta$	0.0047	0.0052	0.0087	0.0175	0.0332
$GM_L = \frac{M}{\Delta \sin d\theta}$ =	3.88	7.02	8.39	8.34	8.80
17' Exc	F_H = 250.2	F_V = 75.1		Δ =	1359.8
M o M	25.0	50.0	100.0	200.0	400.0
$d\theta$	0.1	0.2	0.4	0.8	1.6
$\sin d\theta$	0.0017	0.0047	0.0070	0.0140	0.0279
$GM_L = \frac{M}{\Delta \sin d\theta}$ =	10.82	7.82	10.50	10.50	10.54

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY MCDERMOTT & CO., INC.

COMPANY | SHEET NO

SUBJECT

DRAWING NUMBER | COMPUTER | CHECKED BY | DATE 1. 6. 66

18' EXC F_H = 343.5 F_V = 103.1 Δ = 1343.8

MoM	25.0	50.0	100.0	200.0	400.0
$d\theta$ =	0.1	0.2	0.3	0.6	1.2
SIN $d\theta$ =	0.0017	0.0047	0.0070	0.0105	0.0209
$GM_V = \frac{M}{\Delta \sin d\theta}$ =	10.96	7.91	10.63	14.17	14.24

19' EXC F_H = 530.8 F_V = 162.9 Δ = 1305.7

MoM	25.0	50.0	100.0	200.0	400.0
$d\theta$ =	0.1	0.15	0.2	0.5	0.9
SIN $d\theta$ =	0.0017	0.0026	0.0047	0.0087	0.0157
$GM_V = \frac{M}{\Delta \sin d\theta}$ =	11.26	14.75	16.29	17.61	19.51

EXCURSION	HORIZ MOORING FORCE	GM_V
2	8.2	3.49
4	17.9	3.76
6	27.8	4.00
8	39.5	4.49
10	57.0	4.39
11	68.0	4.70
12	81.9	5.01
13	97.9	5.73
14	120.0	6.16
15	147.7	8.91
16	189.3	7.29
17	250.2	10.04
18	343.5	11.58
19	530.8	15.88

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO
SUBJECT: PERIOD OF HEAVE FOR BUOY			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 1-4-66

60' WD

V_1 NORMAL WD 8.4

V_1 WD + 25 17.6

$K/FT = \frac{17.6 - 8.4}{25} = 0.37\ K/FT$

150' WD

V_1 WD = 25.4

V_1 WD + 25 = 25.7

$K/FT = \frac{25.7 - 25.4}{25} \simeq 0$

K/FT FOR BUOY $= \left(\frac{\pi \times 40^2}{4} - \frac{\pi \times 8.5^2}{4}\right) \times 0.064 = 76.76\ K/FT$ (1,256 − 56.7)

PERIOD OF HEAVE 60' WD $= \frac{2\pi}{\sqrt{\frac{g \times K/FT}{\Delta + \text{ADD MASS WT}}}} = \frac{6.28}{\sqrt{\frac{32.2 \times (76.76 + 0.37)}{5,955}}}$

$= \frac{6.28}{\sqrt{0.9171}} = \frac{6.28}{0.65} = 9.66\ SEC$

PERIOD OF HEAVE 150' WD $= \frac{2\pi}{\sqrt{\frac{g \times K/FT}{\Delta + \text{ADD MASS WT}}}} = \frac{6.28}{\sqrt{\frac{32.2 \times 76.76}{5951}}} =$

$= \frac{6.28}{\sqrt{0.9149}} = \frac{6.28}{0.64} = 9.81\ SEC$

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY MCDERMOTT & CO., INC.

COMPANY			SHEET NO
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 1-6-66

60' WD

PERIOD OF ROLL = $\frac{1.108K}{\sqrt{GM_t}} = \frac{1108 \times 20.96}{\sqrt{3.32}} = \frac{23.22}{1.82} = 12.76$ SEC

PERIODS OF PITCH =

0	$\frac{1.108 \times 20.02}{\sqrt{3.32}}$	$\frac{22.18}{1.82}$	12.19 SEC
50 to	$\frac{22.18}{\sqrt{4.51}}$	$\frac{22.18}{2.12}$	10.46 SEC
100	$\frac{22.18}{\sqrt{5.69}}$	$\frac{22.18}{2.39}$	9.28 SEC
150	$\frac{22.18}{\sqrt{6.88}}$	$\frac{22.18}{2.62}$	8.47 SEC
200	$\frac{22.18}{\sqrt{8.06}}$	$\frac{22.18}{2.84}$	7.81 SEC
250	$\frac{22.18}{\sqrt{9.25}}$	$\frac{22.18}{3.04}$	7.30 SEC
300	$\frac{22.18}{\sqrt{10.44}}$	$\frac{22.18}{3.23}$	6.87 SEC
350	$\frac{22.18}{\sqrt{11.62}}$	$\frac{22.18}{3.41}$	6.50 SEC
400	$\frac{22.18}{\sqrt{12.81}}$	$\frac{22.18}{3.57}$	6.21 SEC
450	$\frac{22.18}{\sqrt{13.99}}$	$\frac{22.18}{3.74}$	5.93 SEC
500	$\frac{22.18}{\sqrt{15.18}}$	$\frac{22.18}{3.90}$	5.69 SEC

PERIOD OF SWAY = $\frac{2\pi}{\sqrt{\frac{8\pi}{2\Delta}}} = \frac{2\pi}{\sqrt{\frac{32.2 \times 9.0}{2 \times 1341.4}}} = \frac{2\pi}{\sqrt{\frac{289.8}{2.6848}}} = \frac{2\pi}{\sqrt{0.1075}} = \frac{6.28}{0.33} = 19.03$ SEC

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MED 5015

J. RAY MCDERMOTT & CO., INC.

COMPANY			SHEET NO
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 1-7-66

60'WD

PERIODS OF SURGE

HORIZ MOORING LOAD

0 $\frac{6.28}{\sqrt{\frac{32.2 \times 300}{2 \times 1394.9}}} = \frac{6.28}{\sqrt{\frac{2858}{2694.8}}} = \frac{6.28}{\sqrt{0.1075}} = \frac{6.28}{0.33} = 19.03$ SEC

50 $\frac{6.28}{\sqrt{\frac{32.2 \times 290}{2694.8}}} = \frac{6.28}{\sqrt{\frac{676.2}{2694.8}}} = \frac{6.28}{\sqrt{0.2509}} = \frac{6.28}{0.50} = 12.56$ SEC

100 $\frac{6.28}{\sqrt{\frac{32.2 \times 285}{6694.8}}} = \frac{6.28}{\sqrt{\frac{1110.9}{2694.8}}} = \frac{6.28}{\sqrt{0.4122}} = \frac{6.28}{0.64} = 9.81$ SEC

150 $\frac{6.28}{\sqrt{\frac{32.2 \times 565}{2694.8}}} = \frac{6.28}{\sqrt{\frac{1883.7}{2694.8}}} = \frac{6.28}{\sqrt{0.5990}} = \frac{6.28}{0.84} = 7.48$ SEC

200 $\frac{6.28}{\sqrt{\frac{32.2 \times 940}{2694.8}}} = \frac{6.28}{\sqrt{\frac{3026.8}{2694.8}}} = \frac{6.28}{\sqrt{1.1232}} = \frac{6.28}{1.06} = 5.92$ SEC

250 $\frac{6.28}{\sqrt{\frac{32.2 \times 1485}{2694.8}}} = \frac{6.28}{\sqrt{\frac{4582.5}{2694.8}}} = \frac{6.28}{\sqrt{1.7398}} = \frac{6.28}{1.32} = 4.76$ SEC

300 $\frac{6.28}{\sqrt{\frac{32.2 \times 2050}{2694.8}}} = \frac{6.28}{\sqrt{\frac{6601.0}{2694.8}}} = \frac{6.28}{\sqrt{2.4495}} = \frac{6.28}{1.57} = 4.00$ SEC

350 $\frac{6.28}{\sqrt{\frac{32.2 \times 2860}{2694.8}}} = \frac{6.28}{\sqrt{\frac{9209.3}{2694.8}}} = \frac{6.28}{\sqrt{3.4174}} = \frac{6.28}{1.85} = 3.39$ SEC

400 $\frac{6.28}{\sqrt{\frac{32.2 \times 3810}{2694.8}}} = \frac{6.28}{\sqrt{\frac{12,922.2}{2694.8}}} = \frac{6.28}{\sqrt{4.6123}} = \frac{6.28}{2.15} = 2.92$ SEC

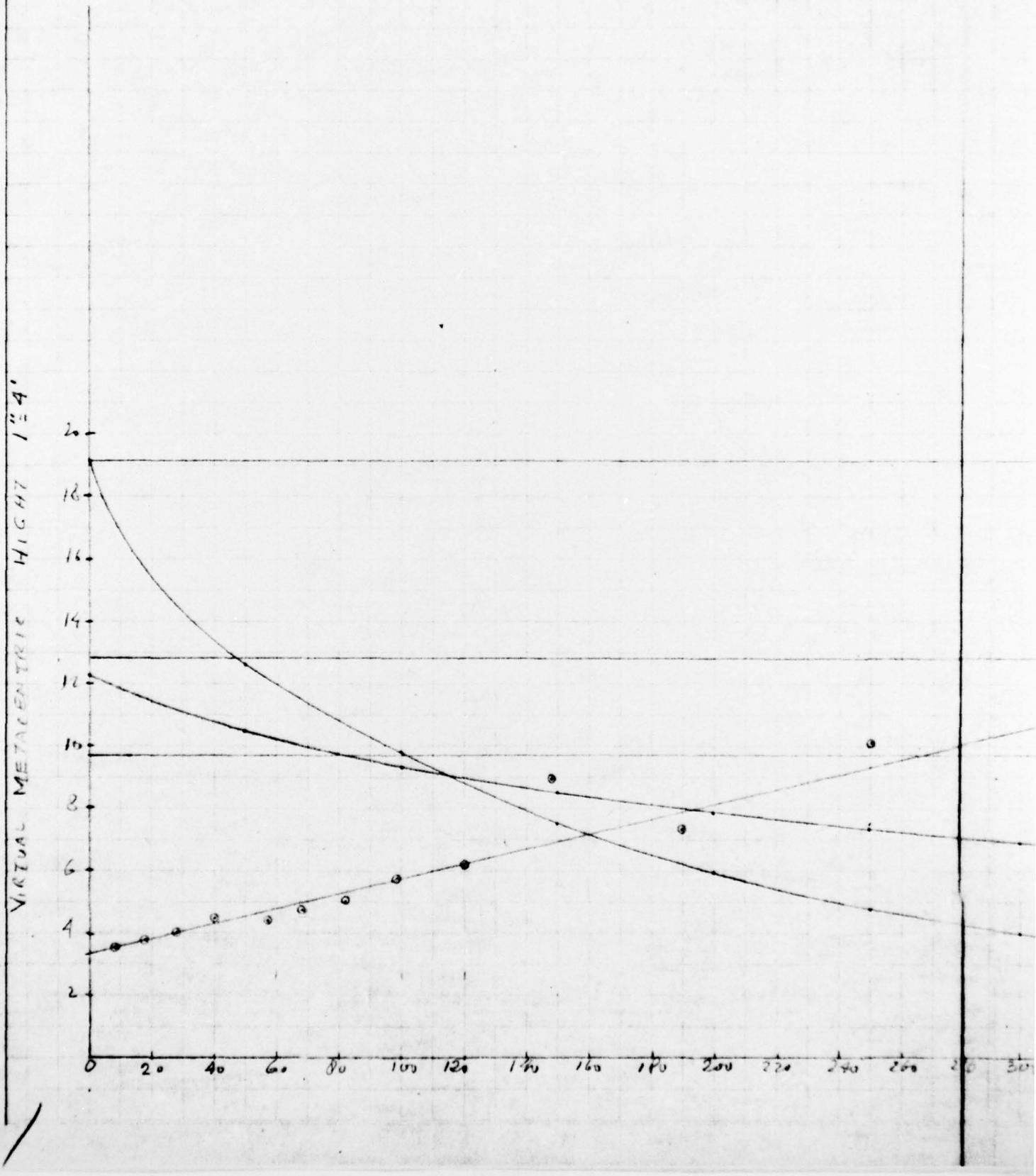
450 $\frac{6.28}{\sqrt{\frac{32.2 \times 4995}{2694.8}}} = \frac{6.28}{\sqrt{\frac{15,933.1}{2694.8}}} = \frac{6.28}{\sqrt{5.9207}} = \frac{6.28}{2.43} = 2.58$ SEC

500 $\frac{6.28}{\sqrt{\frac{32.2 \times 6110}{2694.8}}} = \frac{6.28}{\sqrt{\frac{19,674.2}{2694.8}}} = \frac{6.28}{\sqrt{7.3008}} = \frac{6.28}{2.70} = 2.33$ SEC

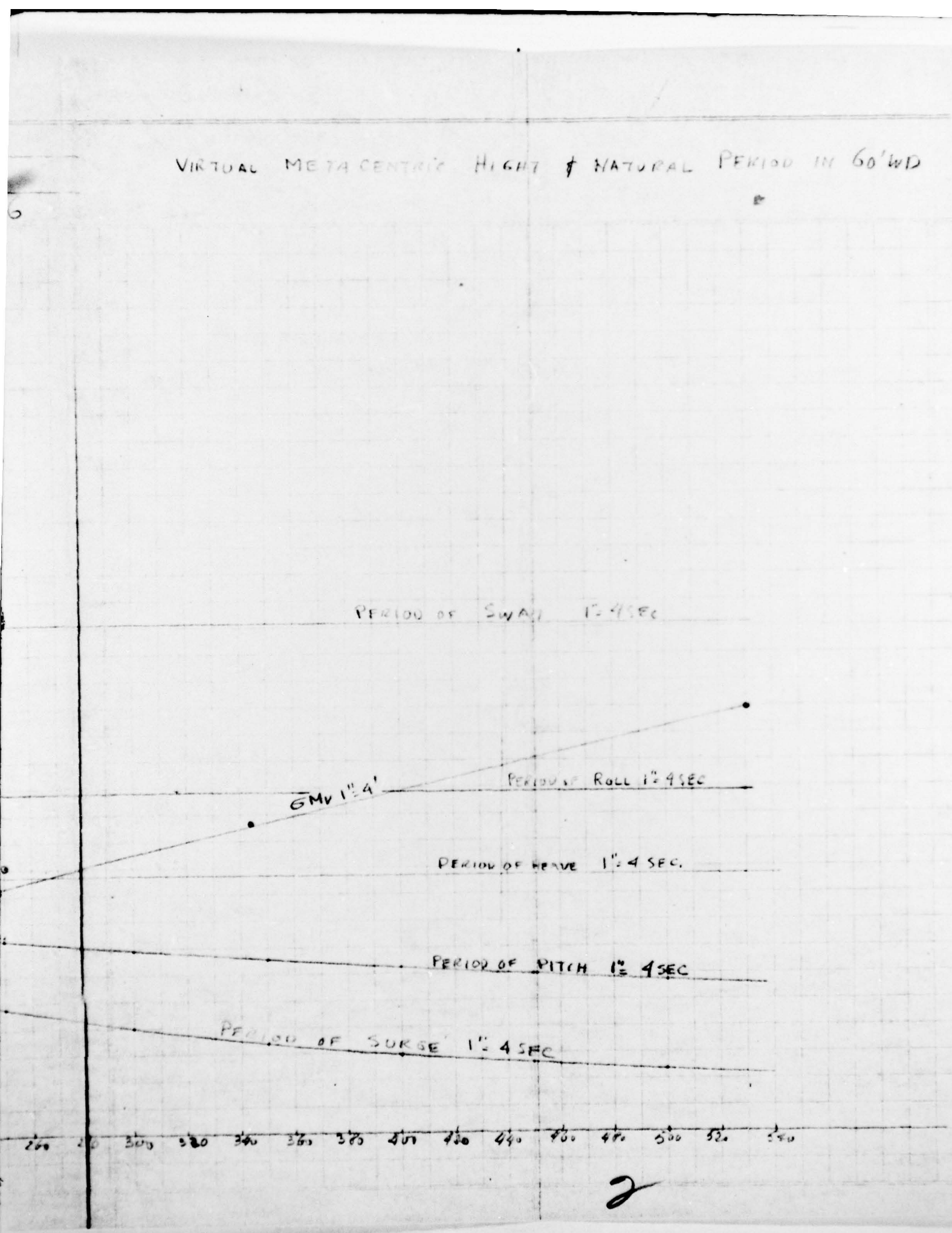
ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

J. RAY MCDERMOTT & CO., INC.

COMPANY			SHEET NO
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 1-6-66



VIRTUAL METACENTRIC HIGHT & NATURAL PERIOD IN 60'WD



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ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

COMPANY | SHEET NO

SUBJECT: MOTION EQUATIONS FOR BUOY

DRAWING NUMBER | COMPUTER | CHECKED BY | DATE 1-10-66

$$A H = \frac{H}{2} \times \mathcal{M}_z$$

$$A P = \ddot{v}_{m\psi} \times \mathcal{M}_\psi$$

$$A R = \ddot{v}_{m\varphi} \times \mathcal{M}_\varphi$$

$$A SU = \frac{\ddot{v}_{m\psi} \times \Delta}{M_{VSU} \times \omega^2} \times \mathcal{M}_x$$

$$A SW = \frac{\ddot{v}_{m\psi} \times \Delta}{M_{VSW} \times \omega^2} \times \mathcal{M}_y$$

FOR BUOY $M_{VSU} = M_{VSW}$

$$\ddot{v}_{m\psi} = \frac{2\pi^2 H \cos\chi}{g (T_w)^2}$$

$$\ddot{v}_{m\varphi} = \frac{2\pi^2 H \sin\chi}{g (T_w)^2}$$

$$\mathcal{M}_z = \sqrt{\frac{1 + k_z^2 \Lambda_z^2}{(1-\Lambda_z^2)^2 + k_z^2 \Lambda_z^2}}$$

$$\mathcal{M}_\psi = \sqrt{\frac{1 + k_\psi^2 \Lambda_\psi^2}{(1-\Lambda_\psi^2)^2 + k_\psi^2 \Lambda_\psi^2}}$$

$$\mathcal{M}_\varphi = \sqrt{\frac{1 + k_\varphi^2 \Lambda_\varphi^2}{(1-\Lambda_\varphi^2)^2 + k_\varphi^2 \Lambda_\varphi^2}}$$

$$\mathcal{M}_x = \sqrt{\frac{1 + k_x^2 \Lambda_x^2}{(1-\Lambda_x^2)^2 + k_x^2 \Lambda_x^2}}$$

$$\mathcal{M}_y = \sqrt{\frac{1 + k_y^2 \Lambda_y^2}{(1-\Lambda_y^2)^2 + k_y^2 \Lambda_y^2}}$$

$k_z = 0.8$
$k_\psi = 0.5$
$k_\varphi = 0.5$
$k_x = 0.3$
$k_y = 0.3$

$$\Lambda_z = \frac{T_z}{T_w} \qquad \Lambda_x = \frac{T_{xx}}{T_w}$$

$$\Lambda_\psi = \frac{T_\psi}{T_w} \qquad \Lambda_y = \frac{T_y}{T_w}$$

$$\Lambda_\varphi = \frac{T_\varphi}{T_w}$$

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 5015

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO.
SUBJECT: WAVE STEEPNESS INVESTIGATION			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE: 1-10-66

MAX WAVE STEEPNESS $\lambda/H = 6.0$ (BREAKING WAVE)

FOR $H = 10'$ $\lambda = 60'$ $\lambda = 5.125\, T_w^2$

$T_w = \sqrt{\frac{60}{5.129}} = \sqrt{11.7} = 3.4$

MAX WAVE STEEPNESS $\lambda/H = 10.0$ (NOT BREAKING)

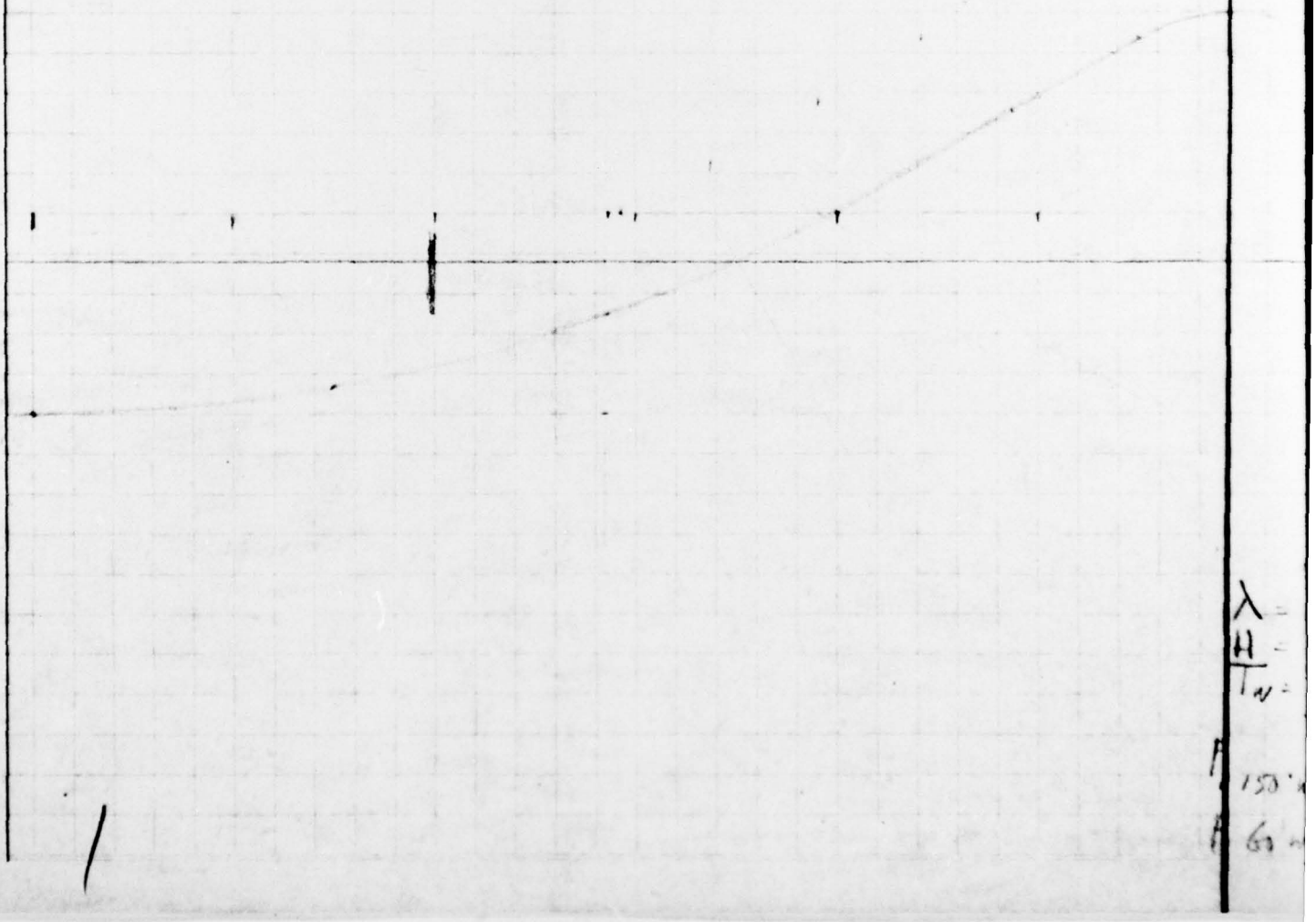
FOR $H = 10'$ $\lambda = 100'$

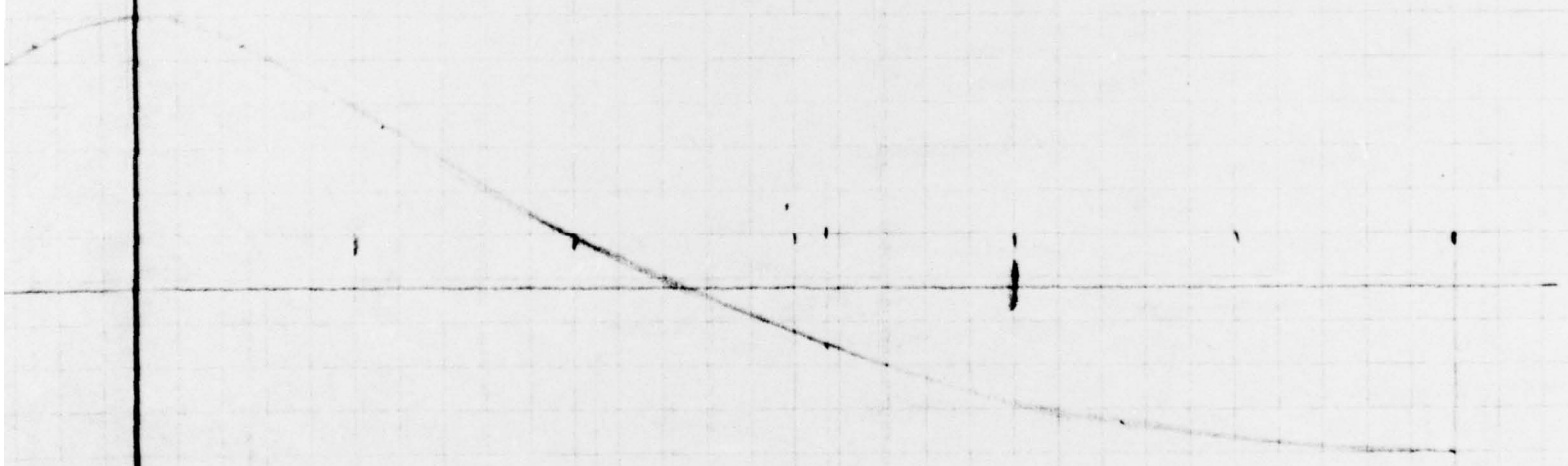
$T_w = \sqrt{\frac{100}{5.127}} = \sqrt{19.5} = 4.4$ SEC

ENGINEERING DEPARTMENT
COMPUTATION SHEET
MCD 14003

J. RAY McDERMOTT & CO., INC.

COMPANY			SHEET NO.
SUBJECT			
DRAWING NUMBER	COMPUTER	CHECKED BY	DATE 1-10 66





$\lambda = 60'$
$H = 10'$
$T_N = 3.4 SEC$

$P_{150' WD} = 410^K$ FOR $T_{SURGE} = 3.4$ SEC

$P_{60' WD} = 340^K$ FOR $T_{SURGE} = 3.4$ SEC